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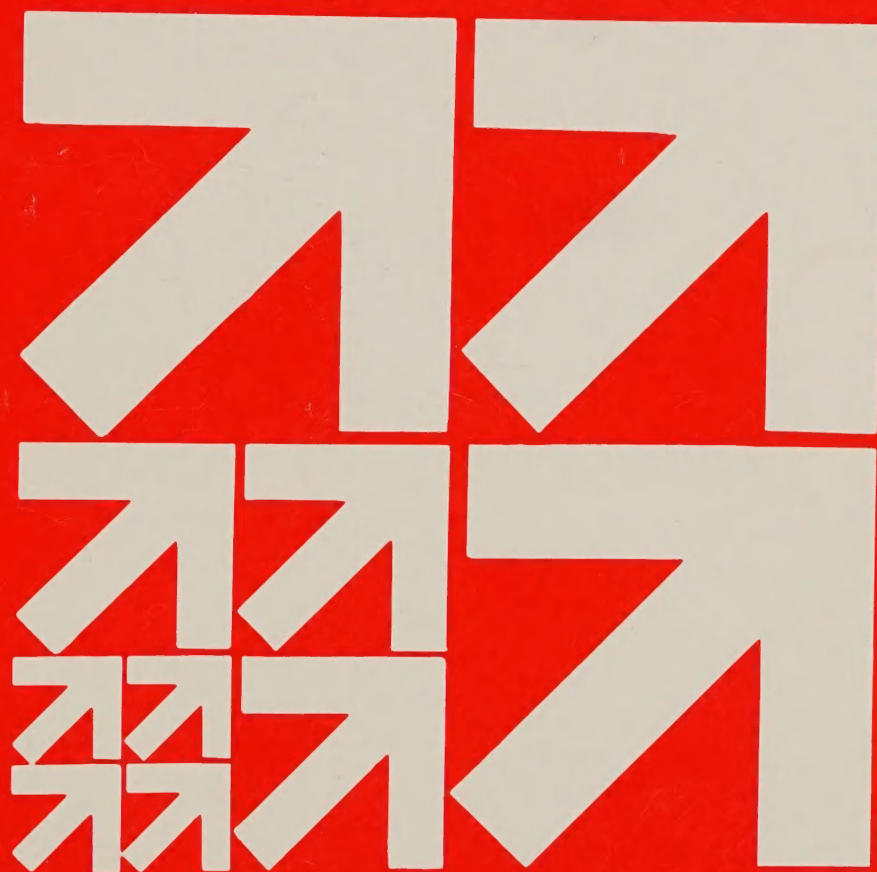
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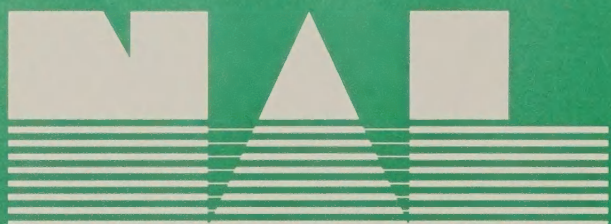
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New Farm and Forest Products

Responses to the Challenges
And Opportunities Facing
American Agriculture



**United States
Department of
Agriculture**



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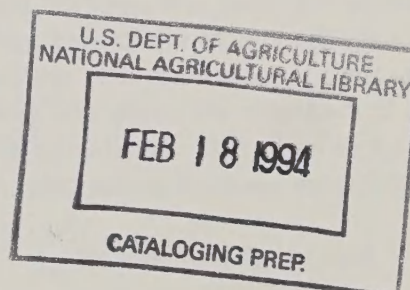
New Farm and Forest Products

Responses to the Challenges
And Opportunities Facing
American Agriculture



A Report from The New Farm and
Forest Products Task Force to
The Secretary, U.S. Department of
Agriculture, Washington, D.C.

June 25, 1987





United States
Department of
Agriculture

New Farm and
Forest Products
Task Force

Hamilton Building
Room 635
Washington, D.C. 20250-2200

June 25, 1987

Honorable Richard E. Lyng
Secretary of Agriculture
Washington, D. C. 20250

Dear Mr. Secretary:

When the Secretary's Challenge Forum on New Uses for Farm Products was convened in October 1984, it began a dialogue which subsequently led to the formation of the New Farm and Forest Products Task Force. A collaborative effort between industry, academia, and government, our Task Force evolved to address the issues raised at that Forum - issues which we believe are vitally important to the interests of the entire Nation.

Our work over the last two years has convinced us that diversification of agriculture and forestry must become a national priority. Diversification is not only needed to respond to the challenges facing American agriculture, but as a key part of any response to the competitive challenges confronting our entire Nation. As documented in our report, we have found evidence of opportunities for new crops, and other new farm and forest products, to meet real market needs, particularly for industrial uses. Our report therefore proposes specific initiatives to turn such opportunities into realities.

Mr. Secretary, we have recently found our independent results to be remarkably consistent with elements of the President's Competitiveness Initiative launched earlier this year. We also find that 1987 marks notable anniversaries of several significant legislative actions including: the centennial year of the Hatch Act which created the Agricultural Experiment Stations; the 125th anniversary of the founding of your Department; the 25th anniversary of the McIntire-Stennis Act on cooperative forestry research; and, the 10th anniversary of the establishment of an Assistant Secretary for Science and Education. We members of the Task Force hope that our efforts will now serve to catalyze other meaningful actions - ones which will prove to be fitting commemorations to these important precedents.

Respectfully Submitted,

Ronald L. Sampson



New Farm and Forest Products
Task Force

Dr. Ronald L. Sampson, Chairman

Contents

	<i>Page</i>
Letter of Transmittal	i
Table of Contents	ii
Executive Summary	iii
I. Introduction	1
II. Discussion	4
Strategic Options	
Process of Innovation	
Opportunities	
Need	
Rewards	
Past Barriers to Success	
Summary of Situation	
III. Conclusions	23
IV. Recommendations	24
National Priority	
National Goal	
Strategies	
Proposals	
Primary:	
Foundation for New Farm and Forest Products	29
Other:	
Technology Transfer Entity	
Multi-disciplinary Research Centers	
International Programs	
Specific Task Force Efforts	
- Biotechnology	
- Agricultural Information	
- Extension Service	
- Goal Oriented	
V. Concluding Comments	45
Appendices	
Task Force Members and Sponsoring Organizations	
Acknowledgements	
- Task Force Associates	
- Task Force Secretariat	
Draft Legislation for	
the Foundation for New Farm and Forest Products	



Agriculture, including forestry, is a strategically vital industry for the United States. Not only is food security critical to national security, but the Nation's domestic economy and balance of trade are both highly dependent upon agriculture. As America's largest industry, agriculture must necessarily be a cornerstone for prosperity and international competitiveness.

With its production capacities already underutilized, U.S. agriculture is facing major challenges which portend a chronic crisis state. The causes of this crisis are complex and related to global developments, in addition to long-term domestic policies. However, regardless of cause, **America now has an overconcentration of agricultural production in a relatively few major food and feed crops, - crops for which worldwide production is increasing, and global import markets are shrinking.**

Although the possibility of a regional calamity causing a temporary shortfall in supply always exists, current trends offer little hope for long-term relief. Indeed, deepening problems can be expected in the future, as an increasing number of exporting countries will be competing for shrinking export markets. **These realities pose sobering challenges to U.S. policymakers,** as well as the agricultural industry itself.

The New Farm and Forest Products Task Force was formed to respond to these challenges. A collaborative effort between industry, academia, and government, the Task Force evolved in mid-1985 from a previous USDA Challenge Forum to address related issues. Upon formation, the Task Force adopted a mission to define and propose meaningful, actionable initiatives based upon a comprehensive analysis of the situation.

Based on its findings, **the Task Force concluded that diversification of agriculture and forestry must become a national priority.** Indeed, the group concluded that diversification, via both new crops and new uses for existing ones, appears to offer the only alternative which promises to enable both: (1) revitalization of ailing segments of the industries; and (2) realization of the full economic potential which agriculture and forestry hold for the Nation.

Continued efforts to increase efficiency and reduce production costs for current commodities continue to be important; however, in the opinion of the Task Force, at least equal emphasis should be placed on diversification into new crops and other new products. Importantly, the group did find evidence that **significant opportunities exist for new farm and forest products to meet real market needs - particularly in industrial, non-food application areas.**

Based on its findings and conclusions, the New Farm and Forest Products Task Force proposes adoption of the following **national goal:**

To develop and commercialize within 25 years, an array of new farm and forest products, utilizing at least 150 million acres of productive capacity, to meet market needs representing net new demand for agricultural and forestry production.

Such a goal represents the equivalent development of two to three new soybean crops - in about one-half the time the soybean required to rise to its current level of significance. The Task Force estimates that attainment of such a goal today would: generate about 750,000 new jobs; increase farm income by about \$30 billion per year; and annually contribute about \$100 billion in activity to the Nation's economy.

The Task Force believes the proposed goal is appropriate and attainable. However, success in achieving it will require both technological and institutional innovation. Specifically, **success in large scale diversification of American agriculture will depend upon: (1) adoption of appropriate strategies; and (2) implementation of those strategies through initiatives which provide innovative organizational approaches to overcome past limitations and barriers to success.** Although the quality of public agricultural research has always been quite high, concentration upon production of current commodities, and the lack of mechanisms to ensure commercial relevance and effective technology transfer to industry, have been limitations in the past.

The **diversification strategies** recommended by the Task Force are as follows:

1. Increase national emphasis on, and reallocate existing resources to the development of new farm and forest products;
2. Establish a consensus that diversification of agriculture and forestry should be a national priority, based upon an understanding, across a broad spectrum of society, of the vital contributions that agriculture and forestry make to the health and wealth of the Nation;
3. Establish mechanisms to increase private/public sector collaboration and cooperation in the development of new farm and forest products;
4. Establish mechanisms to facilitate agricultural technology transfer, particularly between the public research and private industrial sectors;
5. Ensure that responsible biotechnological developments can proceed at a rate which retains national leadership in agricultural applications; and
6. Establish an organized program to identify opportunities for encouraging, and reducing barriers to, the development of new farm and forest products.

To implement the strategies and thereby enable attainment of the diversification goal, the New Farm and Forest Products Task Force proposes several specific action steps and initiatives. Each proposal addresses a particular need, and is intended to build upon existing, relevant programs and organizations in both the private and public sectors. However, one of the proposals is considered to be of paramount importance. Specifically, the Task Force considers **the establishment of an independent organizational entity, dedicated to achievement of the diversification goal and provided with adequate resources to attain it, is essential for success.**

In its report, **the Task Force proposes the establishment of the Foundation for New Farm and Forest Products.** The proposed organization would be an autonomous, non-profit corporate entity with a mission to foster and facilitate the development and commercialization of new farm and forest products. As conceptualized, the Foundation would be specifically charged with the responsibility to achieve the diversification goal. Bridging both private and public sectors, **the Foundation would serve as an advocate, catalyst, coordinator, and cooperative funding source for the development of new farm and forest products.**

The Foundation proposal builds upon the results of prior studies and proven organizational models. **A key element of the proposal involves establishment of a trust fund to provide a stable, long-term funding source for the needed cooperative private/public sector research programs.** Based on models in other areas of industry and technology, the minimum requirement for such a trust fund would involve a one-time allocation of \$100 million - perhaps generated by a single diversion from current commodity support programs. However, although such a minimal program would represent a step in the right direction, it would be inadequate to undertake the enormous and vitally important task of diversifying American agriculture.

To accomplish the diversification goal, **the Task Force recommends that the Foundation be initially funded by proceeds from a \$1 billion trust fund invested solely in U.S. Treasury securities.** It is proposed that the fund be established by the sale of \$200 million of various commodities held by the Commodity Credit Corporation each year for a five year period. When fully established, income from the trust would annually provide over \$75 million as a significant, sustained source of long term "seed and venture capital". Importantly, investments would be directed toward carefully selected, cooperative projects in which private companies and other public organizations are also willing to invest. Such an approach would leverage funding, help ensure market focus, and also enhance cooperation and technology transfer between the public and private sectors. **Foundation investments would be made with provisions to secure royalty returns from successful projects, and the trust fund would ultimately revert back to the Federal Government.**

As detailed in its report, the Task Force proposes several other initiatives related to: (a) commercialization mechanisms for USDA research; (b) multi-disciplinary university research centers relevant to new farm and forest product technologies; (c) international cooperation to develop agricultural sources for industrial raw materials, on a selective basis as mandated by the Critical Agricultural Materials Act of 1984, PL 98284; and (d) task force efforts to address other specific needs.

The New Farm and Forest Products Task Force views its recommendations and proposals as merely starting points - actions to begin the concerted, long-term effort needed to revitalize U.S. agriculture and forestry, and ensure they remain as cornerstones of American competitiveness and prosperity.



I. INTRODUCTION

The Challenge. . .

The New Farm and Forest Products Task Force evolved as a response to the challenges faced by U.S. agriculture and forestry!

Secretary of Agriculture John Block convened a Challenge Forum in October, 1984, to begin a private/public sector dialogue on the development of new crops and new uses for existing crops, including those from forestry. In opening the Forum, Secretary Block said:

“I’ve called you here to issue a challenge. I want to impress upon you a sharp sense of the importance, the potential, and the urgency of the exploration of new directions for agricultural products and markets. . . .As an industry, agriculture can’t make solid progress until it has decided which way it wants to walk”, he said. “We are rethinking our destination and rethinking the paths we plan to take to get there. Certainly there are some new routes we need to explore.”

Many in the audience took up the challenge, and after subsequent dialogue the New Farm and Forest Products Task Force was formed to continue to address the issues raised at that Forum. Because these issues focused on new crops and new uses for existing crops, they seemingly addressed only narrow aspects of the problems and challenges faced by U. S. agriculture and forestry. However, as the dialogue developed, one point became increasingly obvious to the participants. The relative lack of production and end-use alternatives for U.S. agricultural and forestry products could be seen as a pervasive factor underlying the current crisis situation. Although an admittedly simplistic view, the problems facing U.S. agriculture could be seen as resulting in large measure from an overconcentration of production in a relatively few major food and feed crops.

The Organization. . .

A collaborative effort between the private and public sectors, the Task Force drew about one-half of its membership from industry and other private sector organizations, and about one-quarter each from government and academia. A Secretariat was formed within the Department of Agriculture to provide liaison with the Task Force, while direct coordination and support was provided via the USDA’s Office of Critical Materials. The Task Force held its formative meeting in Washington in June, 1985, with subsequent meetings hosted by the Procter & Gamble Company and the Monsanto Company, as well as the USDA. Although each individual had an organizational sponsor, the group operated independently on a self-sustaining basis without outside budgetary support.

The Approach. . .

The Task Force intended to build upon what was already known and what had already been done. The group recognized that a high level of awareness of, and concern for the problems facing U.S. agriculture already existed. This had resulted in relevant programs being established within both the private and public sectors during the last few years. Accordingly, the Task Force focused on identifying unmet needs and gaps which still existed and could be addressed by new initiatives.

The group's efforts drew upon the wealth of existing knowledge and expertise available throughout the Nation and overseas. Deliberations included: reviews of prior literature and reports; dialogue with other interested organizations and individuals; and, testimony from expert witnesses drawn from the private and public sectors. (These witnesses and other non-member contributors to the work of the Task Force are acknowledged elsewhere as "Task Force Associates".)

In its investigations and deliberations, the Task Force was confronted by a rather overwhelming body of information and ideas. Consequently, the group's initial role was largely one of: (a) analyzing and distilling vast amounts of information into a few key findings and recommendations; and then (b) translating those findings and recommendations into actionable and meaningful proposals. The intention was to complement and enhance the relevant programs already in place throughout the private and public sectors.

The Task . . .

During its initial deliberations, the group became convinced of the need and opportunity to diversify U.S. agriculture and forestry. Consequently, the Task Force adopted the following Mission Statement:

"The New Farm and Forest Products (NFFP) Task Force will devise and propose to the Secretary of Agriculture a plan of action for the implementation of positive steps and initiatives to develop new products from the Nation's farms and forests to be used by the agricultural and industrial communities to meet the needs of the country."

In general terms, the mission was to catalyze action which would lead to more complete utilization of the productive capacity of American agriculture to meet an array of strategic, industrial, economic, and social needs.

Appropriate objectives, strategies, and plans were then adopted to carry out its self-selected mission. To more effectively concentrate its efforts, the group excluded initial considerations of animal-derived products. Attention was therefore focused on the development of new plant-derived farm and forestry products - encompassing both new crops and new uses for existing crops.

To accomplish its mission, the Task Force concentrated on the definition of meaningful, actionable proposals. The group intended to propose a relatively few steps and initiatives which not only warranted priority attention, but also were judged to be actionable. To be actionable, the proposals needed to be specific, and also of a character which could be supported by a broad consensus of differing interest groups—many of whom were represented on the Task Force itself.

The Task Force recognized that diversification of agriculture was not a new idea. Indeed, development of new crops and other new agriculturally-based products had been the subject of many studies and proposals, particularly during the last few decades. However, in spite of such past recognition and attention, relatively little progress had been made to accomplish diversification on the large scale needed to ensure full vitality and productivity for American agriculture and forestry.

Confirmation was therefore needed to support the premise that opportunities exist for new agricultural and forestry products. Focus was maintained on opportunities to meet major, real market needs, so such developments truly would be market-driven and justified. In addition, determination of what is needed to achieve success in the future would necessarily require an understanding of what limited large scale diversification was in the past.



II. DISCUSSION

The New Farm and Forest Products Task Force derived its conclusions and recommendations through analysis of the following considerations:

- A. Strategic options facing agriculture;
- B. Process of innovation as applied to agriculture;
- C. Opportunities for diversification;
- D. Needs for diversification;
- E. Rewards for action and penalties for inaction; and
- F. Past barriers to success.

The discussion below summarizes the group's findings and analysis.

A. Strategic Options

The situation facing the U.S. agricultural industry is really no different from that facing any other industry. Regardless of category, an industry must either innovate or perish. Either new products must be developed to replace those which are obsolete or mature and declining, or the related industry will simply cease to exist. Although this reality has been more obvious for other American industries, it also applies to American agriculture.

Option 1: Abandon Agriculture

The Nation could choose to withdraw support from, and effectively abandon agriculture as an industry. Emphasis could then be placed on the development of some other industry with more (apparent) promise. However, even if the strategic and social consequences of such action could be managed, it is unlikely that any industry or segment of the economy could match, let alone exceed, the current and potential value of agriculture to the economy. Indeed, given the critical importance of agriculture to the Nation, this option is simply not an option!

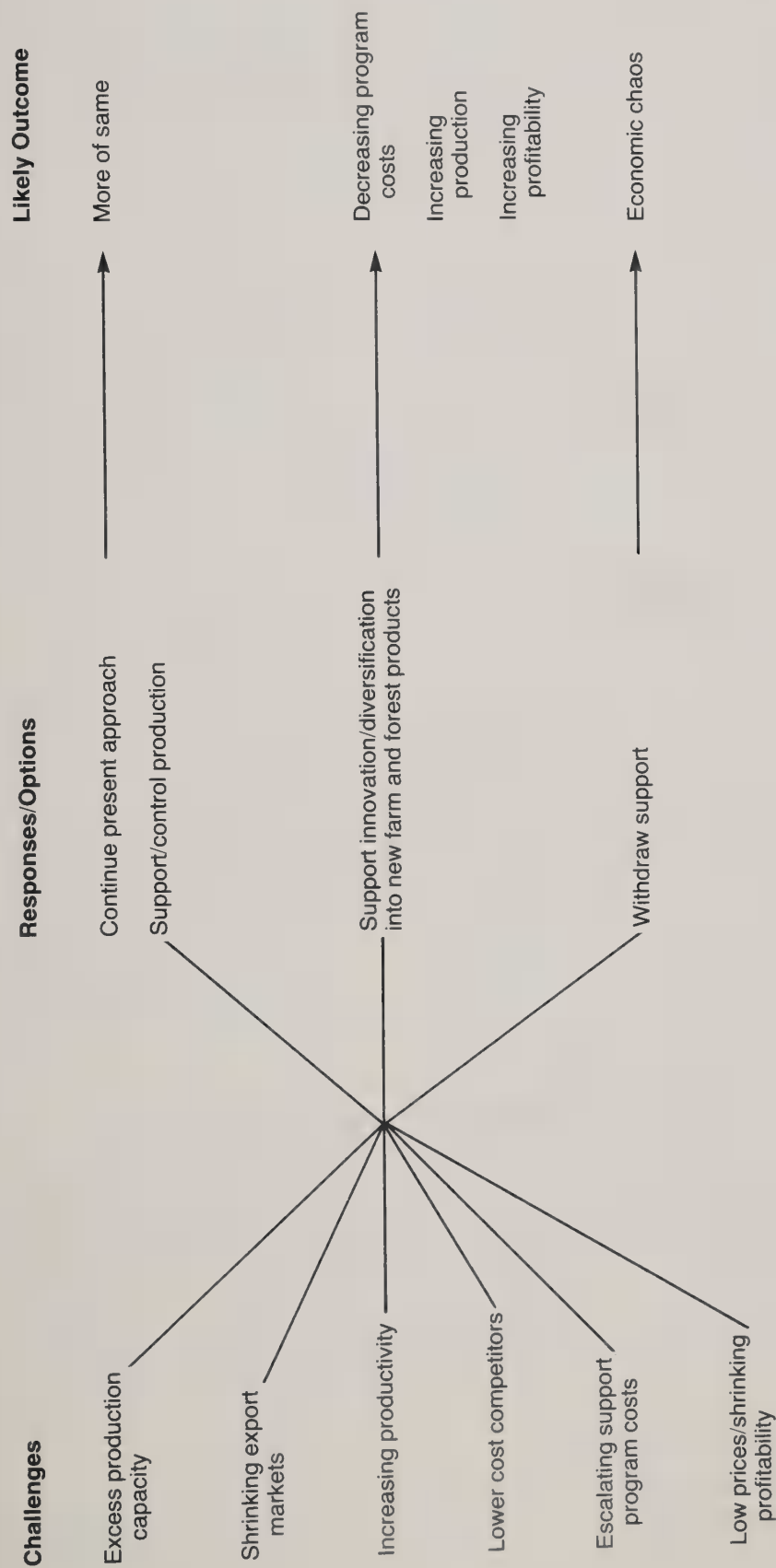
Option 2: Continue Present Course with Present Products

The Nation could continue along the present path of concentrated and somewhat controlled production of current major crops and products. Policy-makers could decide that the current support system via transfer payments should be continued indefinitely, and expanded as required. Under these circumstances, agriculture becomes merely another part of our serious national economic problems, and not part of the cure for them.

Option 3: Innovate with New Products

However, the Nation could also choose to facilitate innovation in agriculture, that is the development and commercialization of new products from American farms and forests. Just as innovation and new products provide the only viable alternative to the demise of other industries, they also provide the only truly viable option for agriculture. For perspective on what this means to agriculture, some consideration of the basic innovation process is worthwhile.

Strategic Options for Agriculture



B. The Process of Innovation

A useful dictionary definition of innovation worth reflection is “the process of creating change by introducing something new”. Innovation therefore means change and new approaches. Regardless of the industrial category, the process of innovation is a very complex and iterative one. However, it can be useful to think of it as a simple linear process of three steps: (1) Discovery; (2) Translation; and (3) Commercialization.

1. Discovery

In the Discovery stage, a basic idea is conceptualized and developed to the point wherein it can be demonstrated in a relatively simple form. Technological discovery usually results from an organized program of research and exploration, and may yield inventions. In this stage, technical feasibility and market potential are assessed on a very preliminary, and largely judgmental, basis. However, particular attention is paid to identifying what market need the concept plausibly addresses. Financing of innovation at this stage is most difficult, and requires use of “seed capital”. This term refers to investments which are made on the basis of judgment or principle because a meaningful analysis of risks and financial returns is not possible.

2. Translation

Concepts, which appear to have sufficient merit, progress to the second phase - Translation. The basic concept is translated into a viable product form and tested. Technical development is married with marketability. The product, and the process to make it, are progressed to the point that commercial viability can be meaningfully assessed. This may include limited commercialization or test marketing. Technical feasibility, market response, costs and potential financial returns are all evaluated to support a decision on whether or not to proceed to market. Innovations in this stage of development require the equivalent of venture capital. Such investments are undertaken at higher levels of risk than traditional financing permits, but based on meaningful analyses of risks and potential rewards.

3. Commercialization

A favorable outcome of the second step of the process leads to Commercialization. The developed and tested product is taken to market, and confirmation of all the prior estimates and projections is made. This is the moment of truth—when the market casts the only meaningful vote. Success is rewarded with financial rewards and business prosperity. However, failure in this stage is costly. Continued survival of a business or an industry depends on the returns from the successes being sufficient to pay back the costs of all the failures as well. Once a venture becomes an established commercial one, traditional financing sources can be utilized.

4. Other Considerations

On the Process. . .

Importantly, the innovation process is **necessarily multi-disciplinary** at each stage because market and technical considerations must be jointly addressed from the

beginning. Nonetheless, each stage requires somewhat differing types and forms of resources. As indicated above, this is particularly true in terms of financing. Uncertainties (i.e., unknown or unquantifiable risks) are the highest in the Discovery stage. As an innovation progresses, uncertainties are transformed into assessable risks, which in turn are translated into known experience. Any development at the initial stage faces extremely **long odds against success and long development timetables** until returns are available from the few successes. Global data reveals that commercial success rates for concepts in the Discovery stage typically range from one to five per cent. In addition, the average time from conceptualization (when investment begins) to commercialization (when financial returns begin) is about seven years.

In agriculture, there are no comparable data available to meaningfully assess the success rates from early stage discoveries. However, comparable rates to those reported in other industries could be expected. Importantly, historical experience suggests **that the timescale for innovation in agriculture is much longer than that of other industries**—with a minimum of ten to twenty years required for new crop developments or major modifications. Although advances in biological technologies promise to accelerate future agricultural developments, they are unlikely to ever accelerate them faster than typical development timetables in other industries.

On Product Reasons-for-Being. . .

It is prudent to seek superior performance, and not cost-savings, as the principle driving force for major new product developments. In this context, superior performance means inherently superior value in the customer's view. In industrial products, it can be objectively measured; however, in consumer products, such as food, subjective preference determines performance value. Of course, the combination of superior performance and lower costs provides the best platform for market success.

Experience indicates that major developmental projects, which require changes in customer habits or product usage, are less likely to succeed commercially when they are predicated solely upon lower costs as a reason-for-being. Experience suggests that in-use cost-reductions, delivered via new products, are far more frequently projected, than actually realized. As a general rule, the projected costs of new products tend to be underestimated. In addition, free-market prices for established, competitive products are moving targets - ones which do not necessarily follow trend-line projections. (In this regard, it should be noted that sugar replacement by corn sweeteners cannot be considered a true exception, since the domestic price of sugar has been controlled and not subjected to normal free-market fluctuations.)

5. The Importance of Innovation

With such low odds for success and long timetables for payouts, why would any industry attempt innovation, that is, new product development? The simple answer is that already suggested—there is no alternative!

Technological Innovation. . .

Mr. Peter Drucker and others have pointed out that technological innovation is key to economic growth and the development of entrepreneurial economies, which avoid the economic stagnations which otherwise result from the decline of mature industries. Although that message was delivered in a general industrial context, it appears to apply quite directly to agriculture—particularly if one views current major agricultural commodities as mature industries face decline.

Institutional Innovation. . .

Professor Vernon Ruttan of the University of Minnesota has pointed out the particular importance of institutional innovation in agricultural developments when he wrote:

“. . .institutional innovations can be designed both to generate technical change in a manner consistent with resource endowments and product demand and to bias the incidence of benefits and burdens in a manner consistent with social policy. Institutional innovation is both a more powerful and a more reliable instrument of reform than technical change. . . .The evidence suggests that the institutional linkages that have provided effective articulation between science, technology, and agriculture have continued to be productive sources of economic growth in both developed and developing countries. There is much that can be learned from this experience by those who are not blinded by outmoded status symbols or cultural constraints.”

Such considerations suggest that **effective responses to the challenges facing American agriculture must necessarily involve both technological and institutional innovation**. However, major steps to foster and facilitate new product innovation in agriculture must be predicated on the existence of real and substantial commercial opportunities.

C. The Opportunities for Diversification

The plant kingdom represents a huge repository of diverse materials and substances which have developed through millions of years of evolution. Fewer than one percent of the species of seed-bearing plants have been utilized commercially, and fewer than three percent have been evaluated commercially. These facts alone suggest that many commercial opportunities still remain hidden in the plant kingdom. However, any experienced developer of products approaches such propositions with skepticism since opportunities are real only if useful products can be cost-effectively found and developed to meet identifiable market needs.

The task of screening and classifying plant materials and matching their potential products with market needs is an awesome one. Such an undertaking requires a carefully planned and administered research program which is focused on market needs and conducted on a multi-disciplinary basis cooperatively between both the private and public sectors. Historically, this combination of conditions has seldom been met.

In its investigations, the Task Force was particularly focused on identifying opportunities in usage categories which would not significantly compete with, or

displace, current U.S. farm or forest products. Such opportunities are of particular interest because they represent potential new market demand for domestic production.

Determination of developmental priorities for specific project opportunities was beyond the scope of the Task Force's program. Nonetheless, the Task Force did find ample evidence for the existence of many, substantial opportunities for new farm and forest products to meet existing and indicated market needs—particularly for industrial raw materials.

The National Agricultural Library in Washington D. C. has established Information Centers in several key subject areas, including Critical Agricultural Materials. Substantial bibliographies on particular new crop candidates can be obtained through the Centers.

1. Industrial Raw Materials

As pointed out in a 1984 Critical Materials Task Force Report on "The Role of American Agriculture and Forestry in Maintaining Supplies of Critical Materials":

"The United States depends on other nations for a broad range of materials and manufactured products important to U.S. industry. Among these are agriculturally produced plant substances and mined materials, including petroleum. Many of these products are or could be agriculturally produced in the United States and used as industrial materials or as renewable replacements for petroleum as a source of feedstock in the chemicals industry. Three of the industrial materials are classified by law as 'strategic,' meaning critical to our national defense. These are natural rubber, castor oil, and sperm whale oil."

As such reports suggest, identifiable market needs (and technical leads to meet them from domestic agricultural sources) do exist; however, the challenges to develop them into economically and commercially viable opportunities are substantial. The examples cited below illustrate such industrial market opportunities for products from both new crops and existing crops. These include:

1. Pulp and fiber products from trees and Kenaf for newsprint, paper, composite structural materials and other products;
2. Rubber, resins and waxes from Guayule for use in tires, tackifiers, coatings, etc.;
3. Industrial oils from the Chinese Tallow Tree, Crambe, Cuphea, Jojoba, Meadowfoam, Rapeseed, and Soybean for use in lubricants, cosmetics, soaps and detergents, plastics, coatings, etc.;
4. Alcohol from Corn, other starchy crops and biomass for use as fuel additives (particularly in applications, such as aviation fuel, where indicated performance advantages exist);

-
5. Absorbents (for moisture removal and chemical separations) and other chemicals from Corn and other starchy crops; and
 6. Carbon char and chemicals from the pyrolysis of hardwoods and woody biomass needed to make high-grade metallurgical products and an array of organic chemicals.

2. High Value Specialty Products

In addition to the industrial product illustrations above, there also appear to be significant opportunities to develop:

- (1) high-value, biologically active products (from both land- and marine-based plant cultivation) for use in pharmaceuticals, insecticides, herbicides and disease control agents for both plants and animals;
- (2) ornamental horticultural products; and
- (3) relatively high value specialty food products from both new horticultural crops and aquaculture.

Long term opportunities for pharmaceuticals to be obtained from plant sources appear significant. They are illustrated by extractives from existing plants, such as the Madagascar periwinkle. They also include potential products derived from genetically modified existing crops. Such prospects are suggested by reports that production of a human hormone (characteristic in pregnancy) has been induced in the petunia. Natural insecticides, such as those reported from the Neem tree, offer other exciting possibilities for effective and environmentally-preferred applications to protect livestock. In horticultural categories, Impatiens demonstrates the opportunities available from germplasm collections overseas. Impatiens is a relatively new ornamental plant product which now generates sales second only to petunia.

Within the last few years, imports of specialty food products have risen dramatically in response to consumer emphasis on nutrition and increased food variety. Nutritional and variety concerns are now quite powerful motivations for consumer purchases, and established consumption trends have created new demands, and therefore opportunities, for new food products. Increasingly being met by imports, the domestic market demand for high value specialty food products now annually amounts to billions of dollars. Many related imports are in categories which hold potential for development of U.S. production sources. Development of the U.S. kiwifruit industry (generating well over \$25 million in annual sales) illustrates how U.S. agriculture can respond to such market opportunities which are first recognized and realized by importers.

Although the value of each specific specialty product might be relatively small when compared with total U.S. agriculture, the cumulative effect (particularly on net profitability) can be quite substantial. It is noteworthy that development of smaller volume, specialty products is a trend which characterizes most industries—particularly those related to consumer products. Indeed, in manufacturing industries, there is markedly increased emphasis on development of flexible

manufacturing systems, which can deliver high quality products for niche markets at competitive costs.

Some of the changes in market demand may be explained by an increasingly segmented population with specific desires and needs. In particular, populations which are more diverse ethnically have greater interest in niche products, particularly in food categories. Such changes in demand patterns can particularly create opportunities for relatively small farms.

3. New Uses for Existing Crops

The Task Force found some current programs, to develop new uses for existing crops, to be particularly encouraging. These were the ones which were primarily focused on delivering superior product performance, and not cost reductions, as the reason for being. An example is found in the effort being mounted, under the sponsorship of the National Corn Growers Association, to develop ethanol as an aviation fuel additive. This project is based on indications that use of alcohol, as an additive, can prevent significant fuel system problems related to moisture and microbial growth in the fuel.

4. Existing Developmental Programs

Additional encouragement was found in the existence of several modest, but promising, cooperative private/public sector projects to develop and commercialize new crops. Some of these projects are related to established programs, such as the ones coordinated by the USDA's Office of Critical Materials. These include the Kenaf (for newsprint) and Guayule (for natural rubber) demonstration projects. Others are based on private sector initiatives, such as the Cuphea research project at Oregon State University. Jointly funded and supported by industry, government and academia, this latter project represents an exploratory effort to develop a new crop source for certain industrial oils.

Although symbolic of the opportunities available to diversify agriculture, such existing programs are relatively small in scope. Consequently, although encouraging they represent only modest, and quite insufficient, steps toward diversification of agriculture on the scale required. Nonetheless, the existence of these programs does support the premise that identifiable opportunities in fact do exist for new farm and forest products to meet real market needs.

5. The Promise of Biotechnology

Biotechnology, particularly in combination with the newly emerging information and robotics technologies, promises to enable the development of new agricultural products which otherwise would not have been possible. Indeed, genetic manipulation, such as recombinant-DNA techniques, enables the transfer of desired properties from potential new crops, or even wild plants in nature, to existing crops. This approach promises the delivery of new agricultural products far more quickly and cost effectively than ever before possible.

Obviously, such prospects suggest a major, new era may be in the offing—one of accelerated plant breeding via biotechnology.

Of course, biotechnological developments present challenges, as well as opportunities. Biotechnological developments promise to increase crop yields per acre and reduce the number of acres needed to produce a given amount of product. This will create additional surplus acreage, and in turn, increase the need for new crop alternatives. Since such changes due to applications of new technologies throughout the world are inescapable, the challenge for America is to lead, and not follow, in such realizations.

Animal-product applications, from biotechnological developments, are generally in a more advanced stage of development than plant-product ones. Indeed, at the present time, biotechnology is not expected to deliver a large scale commercial impact in plant-derived product areas before the end of the century. However, over the longer term, there appear to be greater, and virtually boundless, opportunities for new plant-derived farm and forest products via biotechnology. Most projections on the size of worldwide markets for biotechnologically-derived products indicate the vast majority will be found in agriculture and food products. Estimates suggest such markets will exceed \$100 billion per year in value by the turn of the century. There now seems to be no question as to whether or not biotechnology will have a monumental impact on agriculture. The only questions seem to be: (1) when it will happen; and (2) who will lead in international applications, and thereby reap the most benefits?

With regard to the former question, it is noteworthy that biotechnology appears to be an exception to the general rule that developments take longer than initially predicted. Indeed, the rate of progress in biotechnology appears to be accelerating and, remarkably, it appears that major milestones are frequently passed earlier than predicted. This is in part due to the extraordinary marriage of information technology with biotechnology which appears to be generating much synergism.

With regard to the latter question, it appears that **those countries which can most successfully manage the technology transfer of relevant research results into commercial applications will realize the greatest returns.** It also appears that the rate of commercialization progress in biotechnology will largely be determined by public opinion and support in each country. **Those nations which best manage public uncertainties will likely lead the world in the commercial applications of biotechnology.** In this regard, certain other countries, most notably Japan, have significant advantages over the United States.

D. The Need for Diversification

In the opinion of the Task Force, diversification of American agriculture is of vital importance to the Nation because of the following considerations:

1. The strategic importance of agriculture and forestry to the Nation's economy;
2. The character of the agricultural industry; and
3. The challenges posed to agriculture by global changes and competition.

1. The Importance of Agriculture

Agriculture is a strategically vital American industry! As stated in a recent report by the Office of Technology Assessment:

“Despite numerous theories about ‘post industrial’ societies, agriculture remains a crucial part of the U.S. economy.”

Indeed, U.S. agriculture is the Nation’s largest and most important production industry. As Dr. Dale Wolf of the DuPont Company recently wrote,

“The American food and agriculture system stands atop the ranks of global enterprise. It is the world’s largest commercial industry with assets exceeding \$1 trillion. It accounts for 20 percent of the United States’ gross national product. And more than 23 million Americans are employed in agriculture-related jobs—most of which are beyond the farm gate.”

These facts alone place agriculture well above the combination of steel and automobile industries in employment and overall economic impact.

Agriculture is a significant generator of domestic jobs! Agricultural sectors generate over 25 jobs per \$1 million of output—slightly above that of the automobile industry. Although only a small fraction of these jobs actually are on the farm, the labor productivity of agriculture and related businesses has been growing at a faster rate than that of other sectors of the economy. Forest product industries alone provide jobs to about 1.4 million employees and yield manufactured goods valued at over \$45 billion dollars per year.

American agriculture is an important generator of foreign exchange! For over a decade, agriculture has been a consistently significant contributor to the Nation’s balance of trade, and generated positive surpluses which offset losses in other industries. In addition, according to the Office of Technology Assessment (OTA) about one half of the dollars gained or lost in agricultural trade occur in businesses outside traditional farming sectors.

Agriculture provides strategic food security for the Nation, and forestry provides massive amounts of raw materials for industry! In particular, timber from American forests comprises about a quarter of all the industrial raw materials consumed in this country. Of course, forests are also used to provide a source of heat to millions of homes.

2. The Character of Agriculture

The OTA recently observed that, as one of the Nation’s most capital- and research-intensive industries, agriculture is truly a “**high-technology**” enterprise.

In the words of Dr. Howard Schneiderman of the Monsanto Company,

“Agriculture has made the transition from a resource-based industry to a science-based one. . . technological innovations are crucial to enable the

American farmer to compete in the world's agricultural market place for both U.S. and world-wide markets, and are crucial to enable the nation to realize the economic potential of plants and livestock as annually renewable sources of wealth."

Indeed, the strengths of U.S. agriculture are largely viewed as based: on a strong commitment to the role of science; and, the entrepreneurial spirit of the Nation, which fosters transfer of new technology to the marketplace. The many new and emerging technologies, particularly biotechnology, promise to enable U.S. agriculture to remain a cornerstone for economic prosperity and international competitiveness.

Of course, **agriculture has always been a "bio-tech"** industry! Fundamentally, agriculture is an industry based on biology, and much of the progress achieved in agriculture has been through the genetic manipulation of plants and animals, that is, via breeding processes including forced and random mutations. By providing the technological means to accelerate the process, and actually improve its precision, modern biotechnology (particularly including genetic engineering) appears to offer the means to achieve dramatic future progress in agricultural innovation.

3. The Challenges Faced by Agriculture

American agriculture faces enormous challenges including: (a) excess capacity; (b) a loss of competitiveness; (c) shrinking export markets; and (d) a global trend toward higher valued products.

a. Excess Capacity

The productive capacity of U.S. agriculture is greatly under-utilized. The country today has carryover stocks of between six months and one year's production of major commodities, with productivity continuing to increase at a faster rate than demand. **Estimates of land in excess of production needs to meet both domestic and export market demand range as high as 150 million acres—with about one third of that readily available from the Conservation Reserve Program.** This represents an enormously wasted national asset which, if transformed into a more productive one through new products, would have a profoundly positive impact on the Nation's economy.

b. Loss of Competitiveness

In addition, the ability of the U.S. to compete for the shrinking export markets is handicapped by the fact that on a National average cost basis, **the U.S. is no longer the low cost producer for its major crops!** According to the Office of Technology Assessment, technical advances in other countries now allow foreign producers to grow many important crops below average U.S. costs. U.S. production costs are of course highly variable across regions of the country and producers of different scales. Consequently, while a large percentage of U.S. farms are competitive with the most efficient producing areas of the world, many U.S. farmers are operating at costs which are well above world prices.

c. Shrinking Export Markets

Foreign trade is vital to agriculture, yet agricultural exports are declining! Despite its relative strengths within the Nation's economy, agriculture is highly dependent upon global markets (just as the Nation is highly dependent upon the export earnings of agriculture). In all but eight of the last 64 years, U.S. agricultural production has exceeded domestic demand, and about one-third of production is currently destined for overseas sales.

Nonetheless, U.S. export markets have been shrinking over the last several years, and the agricultural trade surplus for 1986 appears to have been the lowest since 1973. With declining markets, profit margins for producers have narrowed (and even disappeared for some) in spite of the soaring costs of subsidy and price support programs reaching over \$25 billion in 1986 alone.

The causes of the losses in foreign trade are complex and related to many global developments, as well as long-term domestic policies! There is considerable evidence that exports of major U.S. commodities may be facing a continued, long-term decline, and not merely experiencing a self-correcting, temporary downturn. As reported by the Office of Technology Assessment, world exports, as a share of world production, are declining for the key commodities of wheat, corn and soybeans. This appears to largely be the result of fundamental shifts in the global balance of production and consumption. Consequently, **continued shrinkage of export markets for U.S. farm products appears likely—regardless of continued productivity or cost-reduction gains.**

There is evidence that the global quantity of major commodities available for export sales are likely to continue to increase at a rate exceeding import demand for an indefinite period. In other words, global production capacity appears likely to continue to increase faster than consumption demand. This trend is due largely to a worldwide movement toward national self-sufficiency in major food crops—even when the cost of domestic production is higher than imports from lower cost producers. This trend is unlikely to change over the foreseeable future since food security is rather universally considered a paramount national need. In addition, experience has shown that trade negotiations to open, or reopen, inaccessible or restricted food markets face great difficulties.

The 1980 predictions of greatly increased future demand for food commodities from the U.S. and other developed countries have simply not proven to be true. Indeed in the words of Mr. Dennis Avery of the U.S. Department of State,

“The bad news for the American farmer is that the global bad news (of 1980) is wrong. The world is not on the brink of famine or ecological disaster brought on by desperate food needs.”

The world now has in place an enormous and steadily increasing capacity to produce basic agricultural commodities in quantities which well exceed demand. Since the early 1970s, global production of feedgrains and oil crops has been increasing at a rate faster than both population and demand. Indeed, the World Bank has recently concluded that the problems of food shortages in the world are

not due to a lack of available supply or high prices, but rather a lack of purchasing power of some households and nations. That report concludes that **world hunger is not an issue of supply or price, but of poverty and the need for economic growth.**

Net world import markets for basic grains are shrinking! A “green revolution”, triggered by a network of international agricultural research centers, is transforming the agriculture of developing countries and making them increasingly self-sufficient. Farm output in less-developed countries rose by 33 percent in the decade from 1972 to 1982, while that of the developed countries rose only 18 percent. Importantly, the European Common Market also changed from a net importer to net exporter during that period, and became a primary competitor in the world marketplace. Overall, between 1982 and 1985, world production of grain increased by more than 100 million tons annually—with none of the increase coming from the traditional grain exporting countries.

The major effects of increased production in the developing countries was to reduce net import demand, rather than contribute to the world export supply. Nonetheless, the list of the world’s net grain exporters in 1984 included countries such as Burma, Chile, Finland, Hungary, India, and Zimbabwe. Additionally, countries such as Sweden, Norway, Saudi Arabia, China, and Indonesia are now counted among the countries with farm surpluses. In 1985, Bangladesh was nearly self-sufficient in rice production and rapidly becoming a significant producer of wheat as well.

The increases in global production cited above have principally resulted from the introduction of new technologies. These technologies include higher yielding, drought and disease resistant, plant varieties. Changes in governmental policies also have contributed to production gains. These are illustrated by China’s movement toward “free enterprise farming” and the European Common Market’s agricultural production strategies. In addition, the world seems to be on the threshold of a major new era of advances in agricultural productivity. Indeed, as suggested above, the new era of biotechnology promises to deliver even greater increases in productivity than achieved during the previous mechanical and chemical eras.

d. Trends Toward High Value Products

In contrast to the situation for major commodities, international trade in high value agricultural products (HVPs) is increasing! The OTA reports that world trade in HVPs, such as processed commodities and horticultural crops, now exceeds world trade in bulk agricultural commodities. Furthermore, the market value of trade in HVPs is projected to continue to grow significantly during the next few years. Other countries are focusing efforts in such product areas and, as a result, are exceeding U.S. performance in them. In fact, the U.S. now has a negative balance of trade in HVP areas.

As an overview, the realities discussed above suggest a strong need for diversification of agriculture. In the least, they pose sobering challenges to U.S. policy-makers. **Although continued efforts to increase efficiency and reduce produc-**

tion costs for current commodities are certainly justified, such efforts alone appear quite insufficient to address the challenges faced by American agriculture. Indeed, such continued production over-emphasis appears likely to lead to continued reductions in output, and preclude full realization of the great economic potential that U.S. agriculture offers the Nation.

E. The Rewards for Diversification

The potential rewards to the Nation for action to diversify agriculture, and the prospective penalties for inaction, appear substantial. The rewards are found in terms of: economic returns, as illustrated by the soybean; revitalization of ailing sectors of agriculture; increased international competitiveness; and a strengthened national economy.

1. Economic Returns

In general, the economic returns to the community for agricultural research are quite high. For example, it has been reported that in the United States **annual rates of return to the public on expenditures for agricultural research are of the order of 50 percent**. Although such rates of return are highly attractive in community terms, they are of course dispersed across the various sectors of producers, processors, and consumers.

Indicated returns from new crop development expenditures are even more substantial. A socio-economic analysis of the costs and benefits of a 14-year investment made by Canada in rapeseed (Canola) crop development estimated an annual net economic return to their society at slightly over 100 percent.

Despite the fact that the rates of return for investments in new crop developments appear to exceed those of yield increases for existing crops, historical research and development expenditures have been overwhelmingly concentrated in the latter areas. This imbalance is readily understandable since large constituencies exist for current crops, while the constituencies for future crops exist only in the future.

The soybean illustrates both the difficulties and the rewards associated with developing new crops. Investments in soybean research during the early 1900s reportedly met stiff resistance, and it was not until the latter half of the century that the soybean began to realize its potential. Nonetheless, it has been estimated that over the period 1925 to 1985, soybeans contributed over \$500 billion to the nation's economy.

Development of the soybean also contributed to other major changes in the agricultural industry, and in consumer diets. The soybean made available an economical source of high quality protein meal for animal and poultry feed. This in turn led to a dramatic expansion in the production of red meat and poultry products which then, in turn, further expanded the farm economy. In addition, the availability of a economical source of high grade vegetable oil enabled American agriculture to address increasing consumer demands for unsaturated fat and oil products, such as margarine. These needs might otherwise have been met by imported products.

As demonstrated by the soybean example, the potential economic gain to the Nation from the transformation of 150 million acres into a more productive use would be enormous. A relatively new crop to America, the soybean essentially provided an alternative to corn, wheat, and cotton. From 1930 to 1980, soybean plantings increased from insignificance to over 60 million acres. With soybeans generating an annual production value in the range of \$10 to 12 billion, the loss to the U.S. economy would have been immense had that alternative not been developed. (Not only would the indicated income have been lost, but additional excess supplies of the commodities it replaced would likely have resulted.)

Extrapolation of the soybean model to other new crops and products suggests the impact that agricultural diversification might have. **Assuming the 150 million acres of excess capacity were employed to produce new products for industrial uses representing net new market demands, about \$30 billion dollars of new farm income and 750,000 new (off-farm) jobs might be generated!**

Using a typical 2.75 multiplier to estimate the overall effect on economic activity, **the total benefit to the nation's economy could approach \$100 billion per year.** Of course, the intangible social and other benefits of diversification would also be considerable. It is also noteworthy that the returns per acre could be expected to be higher from specialty crops than from commodity crops, like soybeans.

2. Revitalization of Agriculture

Diversification could lead to a revitalization of agricultural sectors currently under much stress. Being market-driven, diversification conceptually provides more options without requiring the dismantling of the present efficient production system for major commodities. If, for example, global demand for basic commodities unexpectedly increased beyond projections, production could be shifted back to maximize producers' returns. Given the responsiveness of annual crop systems, this could be accomplished rather expeditiously. Accordingly, **with increased crop and other product options, U.S. farmers could better respond to global market demands and opportunities.** With increasing sophistication, particularly in the use of information technologies, producers could more readily maximize their returns on a seasonal basis.

3. Increased International Competitiveness

Diversification could also be a key to increased national competitiveness. Under a diversification scenario, the most efficient, low cost producer segment of U.S. agriculture could be unleashed on global markets to maximize national shares of the residual world markets in major commodities. Other producers could concentrate on higher valued and more specialty products, wherein the economies of scale would likely be less important.

4. A Strengthened Economy

Diversification could also lead to a strengthened national economy. With all sectors of agriculture revitalized and productive, agriculture would remain the

cornerstone for rebalancing trade, and ensuring the Nation's competitive leadership. Job growth and increased economic prosperity, arising from both diversification and productivity improvements in agriculture, could also be expected to substantially reduce the need for subsidies and price supports, and eventually enable their orderly phase-out.

On the Penalties for Inaction. . .

Upon reflection, one might conclude that the penalties for inaction on diversification may be as significant as the rewards for action. In spite of the soaring costs of government transfer payments, in the form of price support loans and direct cash advances, there currently appears to be little prospect for relief from increasing commodity stockpiles, family farm stress and tragedy, and international trade tensions. Consequently, **the potential social and economic costs of a continuation along the present path defy estimation.**

F. Past Barriers to Success

To define what must be done differently in the future, one must take advantage of the benefits of hindsight to develop an understanding of why past success was not achieved to the degree it might have been.

As expected, the Task Force found no simple explanation for the lack of large scale success in past attempts to diversify agriculture. However, the group did identify a number of factors which helped to explain why success was so limited in the past. The most notable factors identified were as follows:

1. No constituency or advocate.

There is considerable support for the premise that the lack of either an established constituency, or a credible and influential advocate for new product developments, has severely limited past progress toward diversification. Historically, major agricultural research funding has not been forthcoming until a new crop had already achieved a substantial production base, and thereby established a large constituency. Quite simply, diversification was handicapped by the fact that constituencies didn't exist for crops which didn't (yet) exist.

It is generally recognized that success in any developmental effort is largely dependent upon the existence of an effective product or project "champion". The Task Force found that rule also applied in the few examples of successful new crop developments (including the soybean). In a broad sense, **the lack of an effective champion for agricultural diversification can help explain the lack of consistency and commitment that are necessary preconditions for success.**

2. Inadequate and unstable research funding.

Historically, only a trivial proportion of agricultural research has been directed at the development of new crops and other new products. Since 1957, the Nation has invested less than one per cent of public sector research funding for agriculture to develop new farm and forest products. This inadequacy in funding support could be attributed largely to the absence of either a constituency or champion as suggested above.

Under the constraints of the normal budgetary process, **it appears unlikely that support for any specific agricultural developmental program or project can be sustained for the long time periods (i.e., decades) required for success.** This may be due in part to the lack of an effective long term, project management system to be able to plan, direct and monitor such long range research. Because of the need to ensure such long range programs are proceeding to meet identifiable and changing market needs, innovative management approaches are needed.

Superimposed over this funding allocation problem is the fact that the overall level of agricultural research spending represents only a very small fraction of the current Federal agricultural budget. This concern was emphasized by the Office of Technology Assessment which recently reported:

“ . . . Research spending on agriculture is high throughout the world; indeed, the fraction of non-defense research spending on agriculture in Japan, France and several other nations exceeds that of the United States.”

The Federal agricultural budget is of course primarily dedicated to transfer payments and other support programs. An analysis based upon plausible projections of such spending, and also historical crop development costs, suggests that **projected U.S. spending on farm income stabilization programs during the decade of 1982—1991 might have supported the development of the equivalent of more than 400 new crops.**

3. Dispersion of financial returns.

Although the overall rates of return to the nation for new agricultural developments are quite impressive, they are dispersed between producers, processors and consumers. Such a dispersion of returns and benefits dilutes normal market forces. Although industry's participation is essential to ensure products are developed to meet market needs, industry is inhibited from assuming a leadership role on its own. This is, in large measure, because industry cannot readily project its needed rates of return on investment due to both the dispersion of benefits and also the inordinately long time scales of agricultural developments. Given that consumers are primary beneficiaries of agricultural research and development, public investment in such areas seems particularly well justified.

4. Lack of market focus.

Until recently, even the limited public sector research allocations to new farm and forest products lacked mechanisms to be sure they merged with market needs. Developing products for which there is no market is, of course, not a formula for success. **Research on products and product-related technologies requires direct linkage with the marketplace in order for successful commercialization to proceed.** Historically, there has been no mechanism established to effectively link public sector research resources with market-oriented private sector resources. Indeed, until recent years, there were significant, purposeful barriers to such private/public sector cooperation in the United States. This was in marked contrast with the situations in Western Europe and Japan wherein close collaboration has been the norm.

5. Ineffective technology transfer.

Technology transfer is necessarily a vital step in the process of developing and commercializing new agricultural products. Under any circumstances, even within a single organization, technology transfer at the transitions between the stages in the innovation process is a challenging and difficult task. Inter-organizational technology transfer is even more complex, most of all when it is attempted between the public and private sectors.

The Extension System is a model vehicle for technology transfer to agricultural producers; however, there is no comparable system to link with industry during developmental stages. Although there are recent initiatives oriented toward this need, **historically there has been no effective mechanism to successfully manage technology transfer (and even cooperative technological development) between public sector research entities and industry in agricultural areas.**

In addition, only recently has multi-disciplinary research been emphasized. Development of new farm and forest products particularly requires multi-disciplinary approaches, and therefore requires coordination systems (and incentives) that have not been commonly used in agriculture.

6. High risks and long time scales.

Agricultural product developments, particularly those involving new or modified crops, require commitments over time periods which extend beyond normal commercial boundaries. Private sector investments require projectable rates of return and, as suggested above, projects, which require a decade or more to complete, rarely can be supported solely by private investments. This is particularly true in the absence of long term incentives, such as tax credits, or mechanisms for risk sharing. **The long time scales involved with agricultural developments suggest the need for innovative approaches to meet seed and venture capital needs—particularly ones which leverage both private and public sector funds and resources.**

G. Summary of Situation

Diversification of U.S. agriculture, to the extent needed to fully and productively utilize the Nation's capacity in agriculture and forestry, represents an extraordinarily formidable goal. However, it is one that the Task Force is convinced can be achieved—if the national will exists to achieve it.

Nonetheless, diversification will not provide a quick panacea for the current major problems facing the agricultural industry. **Developing products in harmony with market needs on a meaningful scale will require a major cooperative effort between the private and public sectors.** It will also require an orderly and coordinated mobilization, through reallocation, of the needed resources, and a long time to accomplish. Without such a commitment and mobilization against a well-conceived plan, diversification will simply not occur to any significant degree. In that case, there will likely be even more than 150 million acres of excess productive capacity available in the future.

The Task Force believes that the needed transformation for agriculture can be accomplished through an orderly redirection of existing priorities and reallocation of resources. **Although the strategic importance and magnitude of the task is comparable to those of prior national energy and space programs, the proposed program differs importantly from those others. The proposed agricultural program must clearly be market-driven and responsive to market considerations.** This suggests that, although a sustained significant commitment should be promptly initiated, redeployment of resources must be accomplished in an evolutionary and orderly manner as justified by appropriate combinations of: (a) technological leads; (b) defined market needs; and (c) organized collaborative programs between the private and public sectors to achieve specific objectives.

Development of production alternatives which are the equivalent of two or three soybean crops will likely require decades to accomplish. In fact, the history of the soybean example suggests something on the order of half a century would be needed. However, there is a basis for optimism that developments in the future will likely proceed at a pace which far exceeds anything in the past. For example, progress in world rice improvements resulting from only 25 years of focused interdisciplinary efforts compares quite favorably with the advances realized during the previous 5000 years. If the Nation can retain its leadership in the applications of biotechnology to agriculture, comparisons between future rates of progress and those of the recent past should also be quite impressive.

Such prospects suggest that a goal of developing the equivalent of a soybean crop in half the time of the historical soybean development appears within reach, and plausible. **Development of a total equivalent of two to three soybean crops would require substantial parallel development programs for a large array of crop candidates.** Nonetheless, attainment of such a national goal for agriculture and forestry would clearly establish the industries as cornerstones of American prosperity two or three decades in the future.

With that in mind, it is ironic to note that exactly 30 years ago the Task Group on New and Special Crops reported a positive response to the President's Bipartisan Commission on Increased Industrial Use of Agricultural Products. Had that report catalyzed action to achieve the results they intended, U.S. agriculture might be viewed with a much more satisfying perspective today.



III. CONCLUSIONS

Based on two years of investigations and analysis, the New Farm and Forest Products Task Force affirmed the following overall conclusion:

Diversification represents the only response to the challenges facing U.S. agriculture and forestry which promises to enable both:

- (1) revitalization of ailing segments of the related industries; and
- (2) full realization of the great economic potential which agriculture and forestry hold for the Nation.

More specifically, the Task Force concluded that:

1. Significant opportunities do exist for U.S. agriculture and forestry to be diversified into new crops and other new products to meet real market needs - particularly for industrial, non-food uses;
2. Diversification of agriculture is a vital national need; and
3. Successful diversification of agriculture will require a major, long-term national commitment and innovative approaches which overcome past limitations and barriers to success.

Over the longer term, research and development emphasis on diversification into new products (including both new crops and new uses for existing crops) should gradually increase to a level at least equal to that placed on productivity improvements for existing crops.

It is noteworthy that although the Task Force had initially focused its attention on opportunities for plant-derived products, its conclusions and recommendations were subsequently found to be equally relevant to animal-derived products.



IV. RECOMMENDATIONS

Based on the findings and conclusions described above, the New Farm and Forest Products Task Force recommends adoption of:

- a. Agricultural diversification as a national priority;
- b. A proposed goal for diversification;
- c. A proposed set of strategies to attain the goal; and
- d. Proposed, specific action steps and initiatives directed at meeting organizational and resource-allocation needs for successful goal achievement.

A. A national priority

A national commitment should be made to agricultural diversification into new farm and forest products - particularly those which are directed at industrial market needs. This commitment must be manifested in actions which involve not only technological innovation, but also institutional innovation. In this regard, a key element of the Task Force's recommendations involves establishment of a Foundation for New Farm and Forest Products as outlined below.

Such a commitment to new products should address needs reflected in the other proposals. It also requires an orderly rebalancing of research priorities and resources between the development of new farm and forest products, and that of productivity improvements and cost reductions for current crops. The need for an orderly reallocation of financial resources from current transfer payment programs to appropriate research and development programs is also indicated.

B. A national goal

The Task Force recommends adoption of the following specific National goal:

To develop and commercialize, within the next 25 years, an array of new farm and forest products utilizing at least 150 million acres of productive capacity to meet market needs representing net new demand for agricultural and forestry products.

Shorter term goals should also be defined based on a comprehensive assessment of the current opportunities and technologies available.

As suggested in the discussions above, such a 150 million acre usage goal represents the equivalent of two to three new soybean crops and the amount needed to adequately utilize the Nation's excess productive capacity. In the opinion of the Task Force, such a quantified goal is meaningful, appropriately challenging, and also plausibly attainable.

C. Strategies

Based on its findings, the Task Force believes achievement of the proposed national goal will be dependent upon successful implementation of the following strategies:

1. Increase national emphasis on, and reallocate existing resources to the development of new farm and forest products, particularly those which serve as industrial raw materials;

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2. Establish a broad nationally-based understanding of the critical role that agriculture and forestry play in the health and wealth of the Nation, and a consensus that diversification of agriculture and forestry should be a national priority;
 3. Establish mechanisms to increase private/public sector collaboration and cooperation in the development of new farm and forest products;
 4. Establish mechanisms to facilitate agricultural technology transfer, particularly between the public research and private industrial sectors;
 5. Ensure that responsible biotechnological developments can proceed at a rate which retains national leadership in agricultural applications; and
 6. Establish an organized program to identify opportunities to provide appropriate incentives for, and reduce barriers to development of new farm and forest products.

The following amplifying comments are pertinent to consideration of these strategies.

1. New Product Emphasis.

This strategy is, of course, central to goal achievement, and the other strategies may be viewed as supportive (albeit in some cases prerequisite). Recognition of both the needs and opportunities to diversify agriculture has been documented over decades. However, as previously indicated, new crop and product development has historically received only low levels of funding support - and then only on an erratic basis. Development of new agricultural products and diversification of U.S. agriculture will simply not occur at a meaningful rate unless there is an increased and sustained commitment to such a program accompanied by an adequate reallocation of resources.

2. National Understanding.

Attainment of the proposed diversification goal will require a substantial and sustained national commitment - a commitment which in itself will be dependent upon establishment of a supportive national consensus. Judgmentally, attainment of such a consensus will require policy-makers, educators, researchers and the general public to become better informed about both the importance of agriculture and forestry to the Nation, and also the specific character of these industries. The importance of implementing this strategy was underscored by Professor James T. Bonnen of Michigan State University who stated:

“Agricultural sector political power would appear inadequate to sustain a modern, balanced science base for agriculture. . . . As a consequence, as long-term steady support for agricultural science research has become absolutely critical to the future of an industrialized agriculture, the fragmentation and narrowing of the economic interests in agriculture make it increasingly difficult to mobilize support for long-term goals.”

Farming seems to be regarded by the general public with nostalgia and an abstract form of empathy; however, the kind of informed understanding needed for a consensus on establishing agricultural diversification as a national priority seems to be missing. To fill this gap in understanding, a substantial effort in educational, informational and promotional areas will be required.

3. Private/Public Sector Collaboration.

Because of the complex nature of the agricultural and forestry industries, and the diffusion of returns from them, success in achieving the proposed goal will be highly dependent upon the establishment of effective collaborative efforts between the private and public sectors. Cooperation and dialogue between industry, government, and academia will be essential for meaningful and timely progress to be made. Cooperative funding for related research efforts should be encouraged to leverage the investments from each sector, and also share the risk. Importantly, such cooperative funding also virtually compels an increased level of dialogue and collaboration between the involved organizations. Established mechanisms are also needed to mobilize the resources of industry, government, and academe to address urgent issues and undertake specific tasks and objectives of national priority.

Dr. G. A. Keyworth II emphasized the point when he was Science Advisor to the President:

“The . . . goal of science policy, stimulating partnerships among scientists and engineers in universities, federal laboratories, and industry, reflects the pressing need to improve the transfer and application of new knowledge to national needs, particularly in industry. . . . Better partnerships are clearly needed in the field of agriculture.”

It should be noted that experiences, in other fields of technological development, suggest cooperative development programs are likely to be most effective if approached on a problem-oriented, multi-disciplinary basis.

4. Improved technology transfer.

Mr. Robert M. Coulton of the National Science Foundation describes technology transfer as:

“ . . . a process of information movement and utilization, whereby scientific and engineering knowledge is ultimately converted into marketable products, processes, and services.”

Drs. Roy S. Rauschkolb and L. W. Dewhirst of the University of Arizona stated:

“The term ‘technology transfer’ implies a basic premise that technology or knowledge has some application for the benefit of mankind, therefore making the transfer of it desirable. . . it occurs along a continuum of development and application from the initial conception of the idea or hypothesis to the final application and adoption.”

As discussed above, technological innovation involves long odds against success. This suggests a reason for limited commitments and records of success in technology transfer activities. In the words of Mr. Charles D. DesForges of the Research Corporation Limited in the United Kingdom,

“Technology transfer alone is not a profitable business for either individual universities or industry. Specialized organizations acting in the public interest, which can examine a large number of disclosures, seem to be the only ones capable of bearing the risk of the statistically poor chances of an invention covering overhead costs, let alone making surpluses.”

Two particular categories of technology transfer warrant additional consideration and comment.

a. Between Public and Private Sectors. Because of the breadth of agricultural research across both private and public sectors, effective inter-organizational technology transfer is critical to achieving any meaningful progress in commercializing new agricultural products. Nonetheless, technology transfer between government and industry is an exceedingly difficult task. Importantly, although it has been treated as such in the past, the process is not one of a sequential and uni-directional “technological baton passing”. Rather, as suggested above, it must necessarily be a continuous process. Direct contact and dialogue, between the involved individuals and organizations, must be maintained throughout the entire development process. Although the Extension Service provides an excellent model for technology transfer to the farming community, a parallel function for transfer to industry has not been developed or practiced.

b. Between International Institutions. Because the development of new agricultural products and related technologies is being emphasized throughout the world, developmental programs should also encompass elements of international cooperation. The existence and importance of multi-national corporations also makes such programs necessities. Fortunately, when adopted on a selective basis, international cooperation can lead to acceleration of the development process, without compromise of international competitiveness. In today’s world wherein the rate of global diffusion of technology is so rapid, international cooperation in developmental areas appears to offer much more upside potential for gain, than downside potential for loss. In the words of Mr. G. Edward Shuh of the World Bank,

“We desperately need to shift our perspective from the present one, in which we view doing research on and in other countries as being mainly beneficial to the other country, to one in which we view it as being in our best interest. To be effective in these activities we need to build longer-term relationships with institutions in other countries, with the dual objectives of doing joint research that is in the interest of both countries.”

5. Application of Biotechnology.

As discussed above, agriculture is an industry based on biology and its future largely depends upon biotechnological developments. It is important to note that there is a long established history of experience for biological manipulation in

agriculture. In spite of the randomness of the historical processes, the record is one of unblemished, socially responsible progress.

By providing the technological means to accelerate the process, and actually improve its precision, modern biotechnology appears to offer the means to dramatically accelerate future developmental progress, with much more predictability and control than in the past. Because biotechnology offers the promise of transforming agriculture, in terms of diversity and efficiency, it must be seen as a vital key to future competitiveness for U.S. agriculture and forestry.

As suggested above, the prospects for biotechnology to transform agriculture, into a dramatically more diversified and efficient industry, now appear virtually limitless. However, there are remaining questions of timetable and international leadership. A specific and imposing question is: Who among the countries of the world will lead in commercial agricultural applications, and thereby reap the most benefits for their society?

The United States currently is the world leader in biotechnology; however, several other countries, particularly Japan and members of the European Economic Community, have made major commitments to such areas of research and development, and are not far behind. Consequently, despite this current position of leadership, there appears to be a distinct risk that the U.S. could well become a laggard practitioner of its own technology. This of course has already happened in other technological areas related to manufacturing industries.

Regulatory and legal complexities/uncertainties have substantially slowed vital testing, and application of new biotechnological developments, within the existing framework of domestic agriculture. Consequently, other countries appear to be better poised to exploit the developments of U.S. biotechnology, and may achieve early advantages denied to U.S. industry. Dr. Keyworth captured the situation when he wrote:

“There is little question but that we have made only slow progress in bringing the benefits of the modern biotechnology revolution to American agriculture. The result is that we have failed to take the prudent steps necessary to protect the enormous world leadership that we have enjoyed for so long in agriculture. . . . We have already seen - painfully - how aggressive competitors who adopt new technologies and run with them can make severe inroads into what American industry assumed was a guaranteed market. . . . We would hate to add agriculture to that list 20 years from now.”

Similarly, the Office of Technology Assessment summed up the situation in a recent report which said:

“Many new technologies, particularly biotechnologies, raise unique problems that require a balance between the benefits of research, development, and fielding of new technologies on the one hand, and the interests of public health and safety on the other. A mechanism for dealing with these issues in a fair and expeditious way would facilitate agricultural research and development.”

6. Incentives and Barriers.

As already stated, U.S. agriculture is an enormously complex and ponderous industry which delivers economic and other benefits in a diffuse manner across all groups of society. Frequently the primary beneficiaries of investments in agriculture are consumers and groups other than those making the investments. Consequently, an organized program is needed to identify and advocate the establishment of appropriate incentives and reduction of the barriers.

Examples of such incentives could include: appropriate tax credits for high risk, long range research and development programs; authorization of set-aside acreage use to grow demonstration quantities of developmental crops; and provision of payment guarantees to farmers for production of experimental crops. Judgmentally, an objective organization, which does not carry the burden of beneficial self-interest, would have more credibility and be much more effective in identifying and promoting such changes.

D. Initiatives

The New Farm and Forest Products Task Force has defined, what it believes is, a set of action steps and initiatives to responsibly implement the above strategies, and effectively move toward attainment of the diversification goal for U.S. agriculture and forestry. Although each separate proposal is considered to be meaningful and important, the Task Force views one of its proposed initiatives as paramount and critical. This proposal may also be viewed as a mechanism to implement the other proposed initiatives.

1. The Primary Proposal: Establishment of the Foundation for New Farm and Forest Products

The Task Force considers the establishment of an independent organizational entity, dedicated to achievement of the diversification goal as absolutely vital. As a general principle, any substantial goal can only be achieved if a properly structured and supported organization is established with a dedicated mission, and adequate resources, to reach the goal. Such an entity must be established in a framework which enables it to be not only independent (although highly accountable), but also credible and effective in both the private and public sectors. It must necessarily establish itself as a central focal point, advocate and catalyst for new farm and forest products. To this end, the Task Force strongly recommends establishment of the Foundation for New Farm and Forest Products.

Organization and Structure

An appropriate organizational entity is described in an appended draft legislative bill proposed for its formation. It is intended to be a relatively small organization in terms of staff size and administrative expenditure. To be effective, it must be the kind of assertively proactive, energetic and productive organization that appeals to, and draws upon, the best human talent available in the Nation.

To prevent the Foundation from evolving into a large bureaucratic organization, appropriate constraints on administrative spending must be established which are proportional to the scope of its responsibilities and the magnitude of the resources it controls. Nonetheless, since the effectiveness of the organization will largely

depend on the quality of the people in it, due consideration must be given to providing adequate compensation to superior performers and achievers. This suggests the constraints be more focused on limiting organizational size, not performance-based individual compensation. In particular, individual incentives should be provided to reward delivered results, particularly achievement of notable goals.

As a relatively small organization, the Foundation would necessarily need to work closely and cooperatively with the existing relevant organizations in both the private and public sectors. Indeed, in the opinion of the Task Force, unless such a new organization (big or small) effectively builds on, and enhances the effectiveness of existing organizations and programs, it will fail to accomplish its mission. This premise underlies the Foundation proposal.

Mission and Purposes

As conceptualized, the Foundation would be an autonomous, non-profit corporate entity which has a mission to foster and facilitate the development and commercialization of new farm and forest products. Under the proposal, it would be specifically charged with the responsibility of achieving the stated, quantified goal for diversification of U.S. agriculture and forestry. It also should be charged with the responsibility to facilitate the commercialization of relevant USDA research results - that is, to effectively become the commercial arm of the U.S. Department of Agriculture.

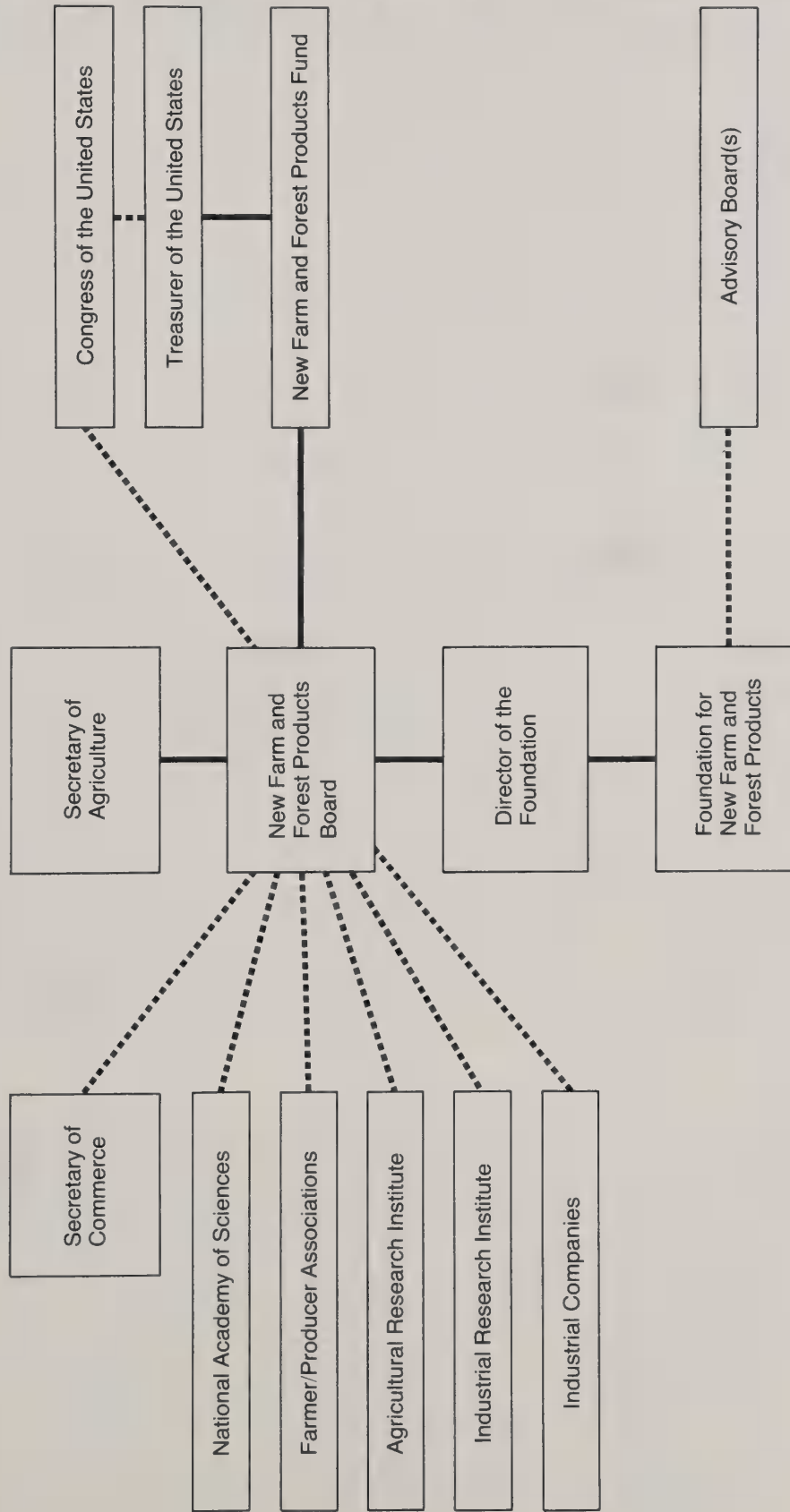
Role and Operations

As indicated above, the Foundation would have primary responsibility for developing and implementing a strategic plan to achieve the national diversification goal. To accomplish such a mission, the Foundation would undertake the roles suggested by the Council for Agricultural Science and Technology for such an organization. One of those roles would be that of identifying and advocating changes which provide incentives for, and reduce barriers to, diversification of U.S. agriculture and forestry. Additionally, in cooperation with other organizations (specifically including the Agricultural Research Service, the Agricultural Research Institute, and the Industrial Research Institute), the Foundation should seek to organize and conduct annual conferences on agricultural diversification.

More importantly, the Foundation would need to be centrally involved in the screening, selection, and financing of cooperative private/public sector projects and joint ventures. To fulfill its multiple roles, it would of course need to build strong direct working linkages with existing organizations having overlapping interests. These organizations should specifically include: the USDA's National Agricultural Library and Office of Critical Materials; the Agricultural Research Institute; the Industrial Research Institute; and the National Association of State Universities and Land Grant Colleges.

Although establishment of a separate entity to act as the commercialization arm for USDA research could be considered, such functional responsibilities should be incorporated within the Foundation. However, if separate entities are established

Structure and Organization: Foundation for New Farm and Forest Products



for each purpose, there must be common overlap between the management and advisory boards of each, to ensure that a high level of cooperation and coordination is achieved between them.

Funding

The Foundation must be funded in a manner which provides the long-term stability and resources needed to achieve success. Financial stability is particularly needed to enable the kind of independence required for the entity to be successful, and also to provide a continuing, predictable source of seed and venture capital funding. Such an entity should develop supplementary funding from private sources, and ultimately become self-funded through returns from successful projects it sponsors. However, given the timescale of agricultural developments, attainment of such a self-funding status will take many years. Accordingly, because its mission is clearly in the national interest, it should be initially funded through a trust fund established by the Federal Government.

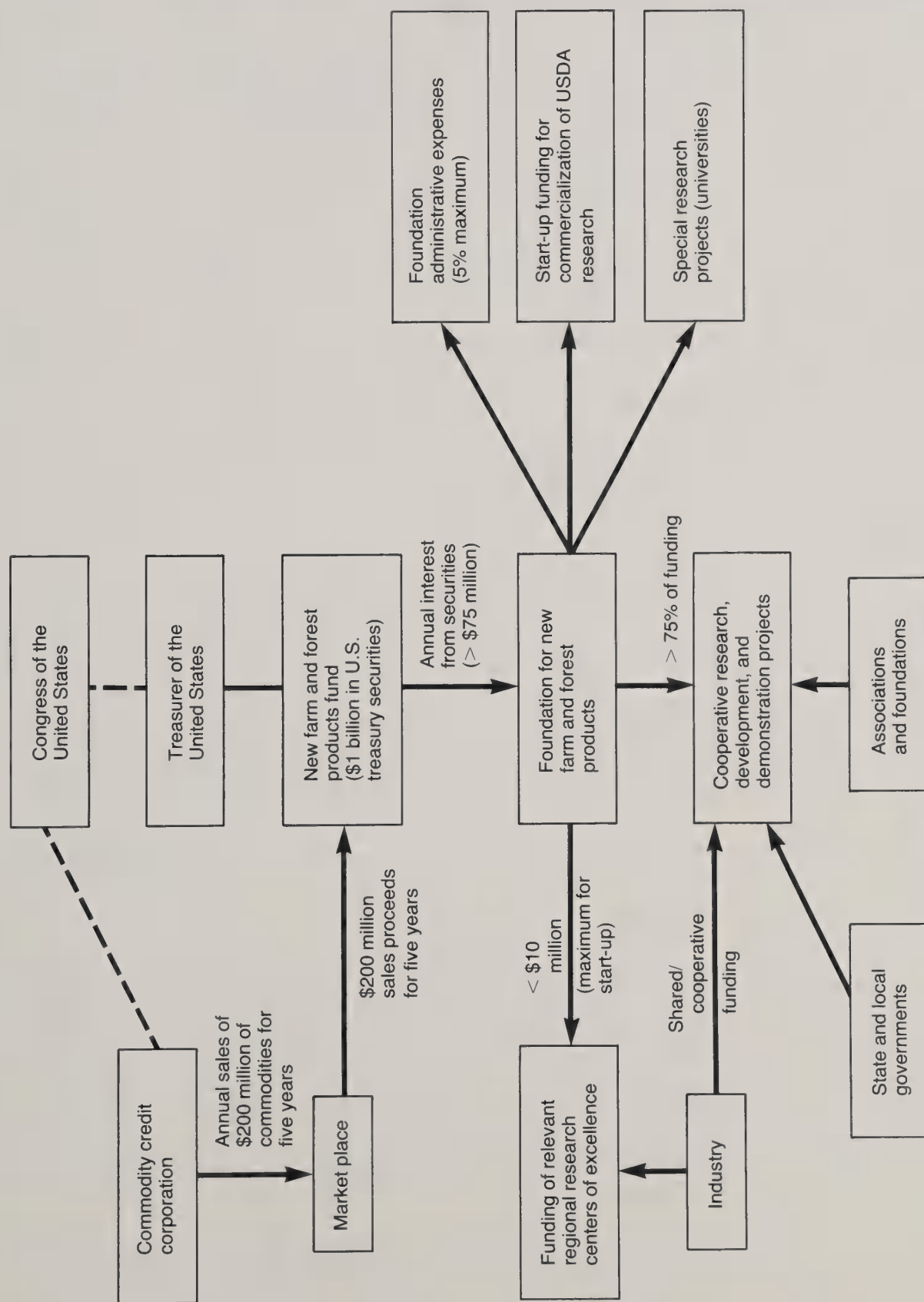
Establishment of a trust fund is key to enabling successful accomplishment of the Foundation's mission and goal. Without a trust fund basis, excessive diversion of Foundation resources would be needed to merely ensure continuing budget support - thus severely detracting from the efficiency of the organization. Dependence upon traditional budgetary processes could also compromise the objectivity and independence needed for the Foundation to be effective. Of course, mechanisms would need to be established to not only ensure appropriate accountability for Government funds, but also accountability for performance in terms of results and goal achievement.

The magnitude of the task to diversify American agriculture by attaining the specific diversification goal dictates the need for a significant investment. Accordingly, **the Task Force recommends that the Foundation be initially funded by proceeds from a \$1 billion trust fund, established by the sale of \$200 million of various commodities held by the Commodity Credit Corporation each year for a five year period.** As proposed, the funds would be invested in U.S. Treasury securities. When fully established should generate an annual interest income of over \$75 million.

Operational and administrative costs should be held to less than five per cent of the annual funds available. The vast majority of funds should be allocated to investment in carefully evaluated and selected research and development projects. As conceptualized, such project investments should only be made on a leveraged basis with both private and other public sector participation. (Such participation would significantly help to ensure the commercial relevance of the research and development work supported.) In addition, provision should be made for royalty returns to the Foundation from successful projects. Provision would also be made for the trust fund to revert back to the Federal Treasury as royalty revenues developed, but no later than twenty years from establishment of the fund.

Prior organizational models, such as the Department of Commerce BIRD program described below, suggest that \$100 million is the minimum needed to establish a trust fund suitable for an entity of the character of the Foundation. However, the

Suggested Funding and Disbursements of Funds: Foundation for New Farm and Forest Products



magnitude and strategic importance of the task to diversify American agriculture suggests such a fund would be inadequate. Although the lower level of funding would support a catalytic organization, which could fill certain roles specified for the Foundation, the funding would clearly be insufficient to permit the entity to be charged with responsibility, and held accountable for attainment of the diversification goal. Although not recommended by the Task Force, if such an alternative approach were taken, the smaller \$100 million trust fund might be allocated by a one-time diversion of \$100 million from current commodity programs. In percentage terms, such a single diversion would represent only a very small redirection from current commodity and transfer payment budgets.

Regardless of source or amount allocated, the trust fund investment could properly be viewed as consistent with the strategic purpose of the current payment programs - to help ensure the (future) financial viability of farm producers. A relatively minor deduction from such current programs offers the potential for immense future returns to both producers and also to the Federal Government itself. (Governmental returns would result from the effects of successful diversification, which should not only reduce needs for future transfer and support payments, but also increase the economic tax base of the agricultural sector.)

Building Blocks for the Foundation

The need for such a Foundation is recognized by prior studies, and the concept is based upon proven operational models. There are several particularly relevant building blocks upon which the Foundation was modeled - each of which is, in itself, built upon much prior learning and study. They are as follows:

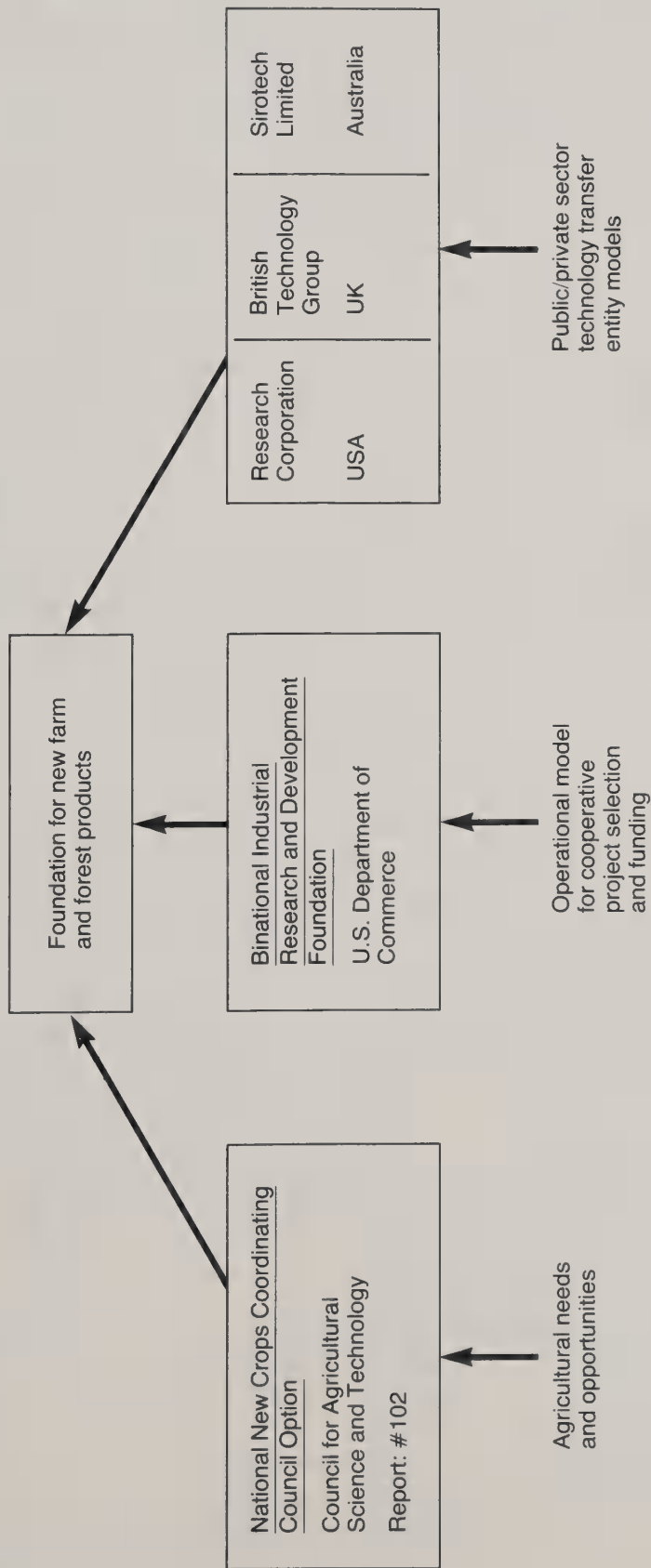
(a) a previous task force report option from the Council for Agricultural Science and Technology (CAST); (b) an operating, organizational model developed and implemented by the Department of Commerce for the Binational Industrial Research and Development Foundation (BIRD-F) program between the United States and Israel; and (c) both domestic and overseas technology transfer entities, particularly the Research Corporation USA, the British Technology Group, and SIROTECH Limited.

A. CAST Task Force Analysis

CAST Report No. 102 was entitled "Development of New Crops: Needs, Procedures, Strategies and Options". In response to a request by the Joint Economic Committee of Congress, the reported study probed related history and issues, and outlined a number of options to address the organizational needs to foster and promote the development of new crops. In the view of the Task Force, the options also could be seen as equally relevant to the development of new uses for existing crops and other new products. (Although not necessarily easier to accomplish, these latter categories are actually easier to support because of the existence of established constituencies.)

One of the options presented by the CAST report involved the establishment of an entity titled the "National New Crops Coordinating Council". This option was described as an independent, joint government-industry entity which would do the

Building Blocks for the Foundation



following: (a) serve as a clearing house for information; (b) maintain a directory of individuals and organizations related to new crop interests and activities; (c) sponsor workshops and conferences to increase awareness, stimulate interest, and promote new crop developments; (d) assist researchers in obtaining financial support, and entrepreneurs in identifying potential partners and funding sources; and (e) promote identification and establishment of appropriate incentives for new crop research, development, and commercialization.

B. BIRD Foundation Model

The BIRD-F program was organized by the U.S. Department of Commerce in 1978 to facilitate the development and commercialization of new products and technologies through binational private/public sector collaboration. Structured as a non-profit, autonomous corporate entity, the functional BIRD-F organization is a small one - only about six staff people. The role of the BIRD-F office is to coordinate analyses of opportunities and selection of projects for support on the basis of merit and potential. Importantly, the BIRD-F office is able to accomplish these roles with limited staffing because: it utilizes state-of-the-art evaluation techniques; and also, it coordinates and draws upon substantial resources within the agencies of each government. These include the U.S. Federal Bureau of Standards (for technical evaluations) and the U.S. Department of Commerce, as well as comparable Israeli agencies.

Entrepreneurial in character, the BIRD-F office facilitates the establishment of international joint ventures (admittedly the most complex of all joint ventures), particularly between small and medium size companies in each country. Using income from its trust fund, the office also assists in funding projects on a matching support basis with the private sector commercial venture partners. Investments are made in a manner which leverages private capital, shares risks, and provides for royalty returns to the BIRD-F fund from successful projects. Importantly, the BIRD-F office was provided with a trust fund of \$110 million to provide seed and venture capital for selected projects. Although modest in scale compared to what is needed for agricultural diversification, the results achieved by the BIRD-F program are impressive. From 1978 through 1986, the office had selected and funded 135 projects with 54 reaching commercialization. The latter group has generated cumulative sales revenues of over \$250 million, and royalties in excess of \$2.5 million. An overall success rate is expected to be well over fifty percent. In view of traditional low success rates, such results would indeed be impressive.

Obviously, the effectiveness of a small organization, such as the BIRD-F office, is highly dependent upon the quality of the people involved (and their ability to tap extensive resource networks). Nonetheless, the BIRD-F operation has achieved a successful track record and does provide a proven and effective organizational model upon which to build.

C. Technology Transfer Entities

There are many examples of different types of entities which serve as technology transfer vehicles both in the United States and overseas. Domestic entities include

the Research Corporation USA, University Technology, Inc., a non-profit subsidiary of Case Western Reserve University, and the Center for Biotechnology Research, a non-profit corporation associated with Stanford University, the University of California at Berkeley, and the Massachusetts Institute of Technology. Particularly relevant overseas initiatives include the British Technology Group (BTG) in the United Kingdom and SIROTECH in Australia. Several of these provide useful perspectives pertinent to the Foundation proposal.

Research Corporation USA

This corporation is a private foundation created in 1912 to advance basic science and technology by generating funds for a grants program through technology transfer activities. Although relatively modest in scale, the Research Corporation generates an annual royalty income of \$10 million out of services provided to 300 U.S. institutions.

British Technology Group

The precedent organizations upon which the British Technology Group (BTG) was organized were established over 25 years ago. Originally commissioned to broker public sector technology, the organization received over 50 million British Pounds Sterling in funding over a period of years. Based on royalties received from successful technology transfers, BTG long ago paid back the initial investment, and today generates an annual revenue of about 25 million Pounds Sterling.

SIROTECH Limited

Although more limited in history, SIROTECH is quite relevant as a model for technology transfer between Federal Government research laboratories and the private sector. SIROTECH Limited is a statutory body, structured as a non-profit company. It serves as the marketing and technology transfer arm of the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the principal Australian Federal Government's research organization. CSIRO is structured similar to the Agricultural Research Service (ARS) with geographically dispersed research laboratories focused on specific missions. With an overall research budget comparable to that of ARS, CSIRO's research encompasses very diverse categories of technology - although a substantial portion of it is dedicated to agriculturally-related sciences.

Having only been founded in 1984, SIROTECH has already established itself as an effective vehicle for facilitating technology transfer and commercialization of the research results generated by CSIRO. SIROTECH's results are indicated quantitatively in the following financial terms (in U.S. dollars).

a. Royalties. Since 1984, royalty revenues from licensing patented CSIRO technologies have jumped from an annual rate of less than \$140,000 to over \$1 million.

b. Current Contractual Income. Under contractual arrangements with private industry, much research work within CSIRO is now funded from outside. The funding levels have jumped nearly three-fold since CSIRO was formed - from less than \$3 million in 1983/84 to over \$8 million in 1986/87.

c. Assets. On behalf of CSIRO, SIROTECH currently holds equity in joint venture companies. The value of this portfolio now exceeds \$12 million. Formation of such joint ventures with private sector companies was fostered by SIROTECH to commercialize research results from CSIRO. The equity represents the return to date on such research results, and provides the basis for future self-funding and investment seed capital for new ventures.

SIROTECH is funded by a retainer fee from CSIRO under contract between the two organizations. Based on the results to date, it appears that CSIRO is receiving an excellent return on its investment of less than \$1.5 million per year in retainer fees, with even greater returns expected to be generated in the near future.

2. Other Proposals

As stated above, the Foundation proposal is considered by the Task Force as essential to establishing a national commitment to, and achieving the goal of agricultural and forestry diversification. Although the Foundation itself could serve as the organizational instrument to implement the other initiative proposals, they also can be considered independently. These proposals are as follows:

a. Establishment of a Commercialization Entity for U.S.D.A. Research

If such a role is not incorporated within the scope of responsibilities of the Foundation, the Task Force proposes establishment of a non-profit corporate entity similar in structure to the Foundation proposed above, but with the specific mission to facilitate the commercialization of market-relevant USDA research results.

As suggested by the discussions above, new approaches are needed to improve the process of bringing scientific discoveries from the public laboratory to the marketplace. Although new technology transfer mechanisms can be expected to enhance utilizations in all areas of agricultural research, they are particularly needed for the development of new farm and forest products.

Of course, the Department of Agriculture has recognized this general need, and already established certain policies and programs to increase collaboration with industry, and promote the commercial utilization of its research findings. Examples include the establishment of the Office of Critical Materials within the USDA, and establishment of an interactive dialogue between the Agricultural Research Service and the Industrial Research Institute. Although these initiatives do begin to address certain aspects of the technology transfer process, their intended purposes and functional roles are quite limited, and are distinct from those of the proposed entity. Nonetheless, the proposed new entity (whether incorporated within the Foundation or separately structured) would be expected to work closely with, and enhance the effectiveness of the initiatives already in place.

Because private/public sector technology transfer is both important and difficult, it has received much attention in recent years and been the subject of research and

experimentation throughout the world. Accordingly, as indicated above, the Task Force drew upon global precedents and demonstrated models to define the concept of such a technology transfer company (TTC).

As an autonomous company, the TTC should be able to interact with private industry, and directly engage in necessary business activities, in a much more efficient and effective manner than would be possible for a government agency. Examples of such activities could involve direct equity participation in joint ventures with private companies.

Because of its “quasi-private industry” character, the TTC could readily access and engage top marketing talent from the private sector on market competitive and performance-related terms. However, as a non-profit company which is closely linked with, and accountable to, the USDA, it should enjoy a high level of credibility and access in both the private and public sectors. (This has been the observed situation with other similarly structured entities, and is seen to have substantially contributed to their effectiveness.) Importantly, it would be structured to build upon the policies which increase the independence of regional USDA laboratories, and facilitate their closer linkage with industry. As previously suggested, it would also need to work in a closely coordinated way with the Foundation (if separated as an initiative) and other relevant agencies, such as the Office of Critical Materials.

Although the SIROTECH model suggests the appropriateness of a higher funding level, other models, such as BIRD-F office, indicate that an annual budget of about \$500,000 could be sufficient to initiate such an organization. However, such a funding level would require additional USDA “in-kind” support, such as office facilities and support services. Based on the SIROTECH model, a contractual relationship between the USDA and the TTC organization would seem to be appropriate. Relevant experiences with similar organizations suggests that the TTC could be expected to ultimately achieve total self-funding while providing royalty revenues to the USDA.

If, as the Task Force recommends, the technology transfer function is incorporated within the scope of responsibilities and roles of the Foundation for New Farm and Forest Products, no additional allocation of funds would be needed.

b. Establishment of Multidisciplinary “Research Centers of Excellence”

Establishment of several National Centers of Excellence is proposed to focus on research particularly oriented to technologies for new farm and forest products. Modeled after the NSF-sponsored Engineering Research Centers, these collaborative industry/academia centers could be located within selected Land Grant Universities. They should involve several institutions, and be established as cooperative regional centers of excellence in specific categories. Importantly, participation of non-Land Grant Universities, and also departments outside of traditional agricultural disciplines, should be encouraged.

Bringing together industrial and multi-disciplinary academic resources, such centers have proven to be effective vehicles for stimulating industry/university collaboration, and facilitating technology transfer in other areas. Of particular note, such centers also serve to promote temporary or sabbatical exchanges of scientists between industry, government, and academia. Their relevance to agriculture has been suggested by others, such as Mr. Alvin L. Young of the President's Office of Science and Technology Policy, who stated:

"These centers would address opportunities in research and training and would establish foci for industrial, other private sector, and local and state government participation. . . . The centers concept is especially appropriate for the emerging high technology areas of agricultural research."

Under this proposal, the agricultural centers could be focused on research in such subject areas as: agriculturally-based industrial raw materials; bioprocessing and bioengineering; pharmaceuticals and other biologically-active substances from agriculture; and integration of plant breeding & genetic engineering. Based on the NSF model, funding of about \$10 million over five years would support the establishment of about six centers.

Such an initiative might appropriately be undertaken as a cooperative program between the USDA and the National Science Foundation, or directly sponsored by the Foundation. Importantly, this proposal is consistent with the Science and Technology Center element included within the President's Competitiveness Initiative of 1987. It is also consistent with elements of the Five Year Plan For Food and Agricultural Sciences proposed last year by the Joint Council on Food and Agricultural Sciences. The latter plan included recommendations for increased use of multidisciplinary research grants - which would be of sufficient magnitude to catalyze formation of the proposed centers.

c. Establish International Cooperative Development Programs

The Task Force proposes establishment of specific and selective international programs to develop new farm and forest products and related technologies, particularly those which are focused on the development of industrial raw materials. Specifically, **the Task Force recommends initiation of suitable programs under the guidelines and mandates of the Critical Agricultural Materials Act of 1984, PL-98284.** Such programs could include exchanges of scientific personnel, technical data and germplasm, and establishment of developmental joint ventures as specified within the Act. Although the Act's provisions currently only specify such programs with the countries of Australia, Israel, and Mexico, the program could be expanded to include other selected countries if warranted by initial results and experiences with the specified countries.

As indicated above, international cooperation has the potential to accelerate the development of new farm and forest products and other new agriculturally-related technologies. Although there have been historical programs of cooperation, these have largely been oriented toward assisting developing countries. In the context of

agricultural diversification, new emphasis should be placed on programs specifically selected to provide balanced, mutual benefits for each participating country and agency. Programs which internationally link both private and public sectors are likely to be of most value in facilitating the development of new farm and forest products.

As indicated above, such cooperative international development programs with several countries are already encouraged under the Critical Materials Act of 1984. They are also encompassed within recommendations under the Joint Council's Five Year Plan cited above. The Joint Council's recommendations particularly encourage expansion of personnel and technical information exchanges under the auspices of the U.S. Extension system. It is noteworthy that such expanded international programs could also facilitate implementation of the element of the President's Competitiveness Initiative which calls for development of mechanisms "to ensure that information on foreign research is made available in a prompt and efficient manner".

If established in the framework of the existing programs of the USDA's Office of Critical Materials and the Office of International Cooperative Programs, such initiatives could be implemented with only modest incremental additions to existing budgets.

d. Establishment and Support of Specific Task Force Efforts

The Secretary's program of Challenge Forums has proven to be an excellent means of providing focus on major issues and catalyzing voluntary follow-up action. However, there remain needs for addressing specific tasks which do not warrant Challenge Forum attention. In addition, task forces which are oriented to implement, rather than propose action, require support and organization which go beyond the precedents of the Challenge Forums. Specifically, the New Farm and Forest Products Task Force proposes the following additional task force initiatives to address specific needs.

(1) Biotechnology

To begin to implement the related strategy cited above, a task force should be formed to address the issues related to ensuring national leadership in agricultural applications of biotechnology. Hopefully, such a task force will evolve from the recent Challenge Forum on Biotechnology. However, if this does not happen, one should be specifically organized - perhaps under the joint sponsorship of the USDA and relevant biotechnology associations, as well as the Agricultural Research Institute and the Industrial Research Institute.

(2) Agriculture Information and Promotion

To implement the related strategy, a task force, drawing from appropriate private and public sector organizations, should be convened with a mission to develop and implement a national educational and promotional program for agriculture. The Task Force should seek to provide the needed information and perspective to the general public, as well as the decision-makers and scientific communities in industry, academia, and government. Its program should be focused on providing

factual information, and a properly balanced perspective on the scope and role of agriculture in the Nation's health and wealth, and also the potential importance of agricultural diversification.

The program could appropriately be coupled with elements of the Hatch Act Centennial program since the objectives of both programs are complementary and in the public interest. The specific program proposed should include: the organization of national conferences; preparation of literature for public information; organization and coordination of papers for publication and other media coverage; and other direct promotional activities. Such promotional information should also encompass material suitable for use by land-grant administrators, scientists, teachers, and extension personnel in their areas of responsibilities. Primary funding for the effort should be solicited from private associations and foundations, although cooperation of governmental entities should be evident.

Although timeliness of such an endeavor is important, such a new task force initiative could be appropriately organized and led by an organization such as the Agricultural Research Institute or the proposed Foundation for New Farm and Forest Products. In any event, such a program needs to be undertaken as a private and public sector collaborative effort, preferably through the direct involvement of associations, foundations, and industrial groups. These should specifically include the Agricultural Research Institute, the Council for Agricultural Science and Technology, the Industrial Research Institute, and the Joint Council on Food and Agricultural Sciences.

In addition to helping to build the national consensus needed to translate ideas into action, this initiative would also encourage entry of students into agriculturally related fields, and promote increased collaboration with organizations and disciplines outside of traditional agricultural areas.

(3) Extension Service for Industry

As already acknowledged, the U.S. Extension Service provides an exemplary model of effective technology transfer at the particular interface between the technologist and the primary producer. Nonetheless, there is an increasing need to develop improved technology transfer mechanisms at other interfaces, particularly with small to medium sized companies in industry. Many of the developmental programs for new farm and forest products are progressing with the support of such smaller, entrepreneurial companies. Accordingly, there is an increasing need for establishment of some mechanism to link those smaller companies with public research institutions. Assessment on whether and how the Extension Service might undertake such a mission would seem to warrant investigation and assessment by a properly constituted task study group.

(4) Implementation Task Forces.

At a 1986 workshop sponsored by the Agricultural Research Institute, it was recognized that:

“No mechanism seems to exist to focus the researchers, or other appropriate personnel, on needs identified in a whole agricultural system aimed at really solving a specific major problem in a given time frame.”

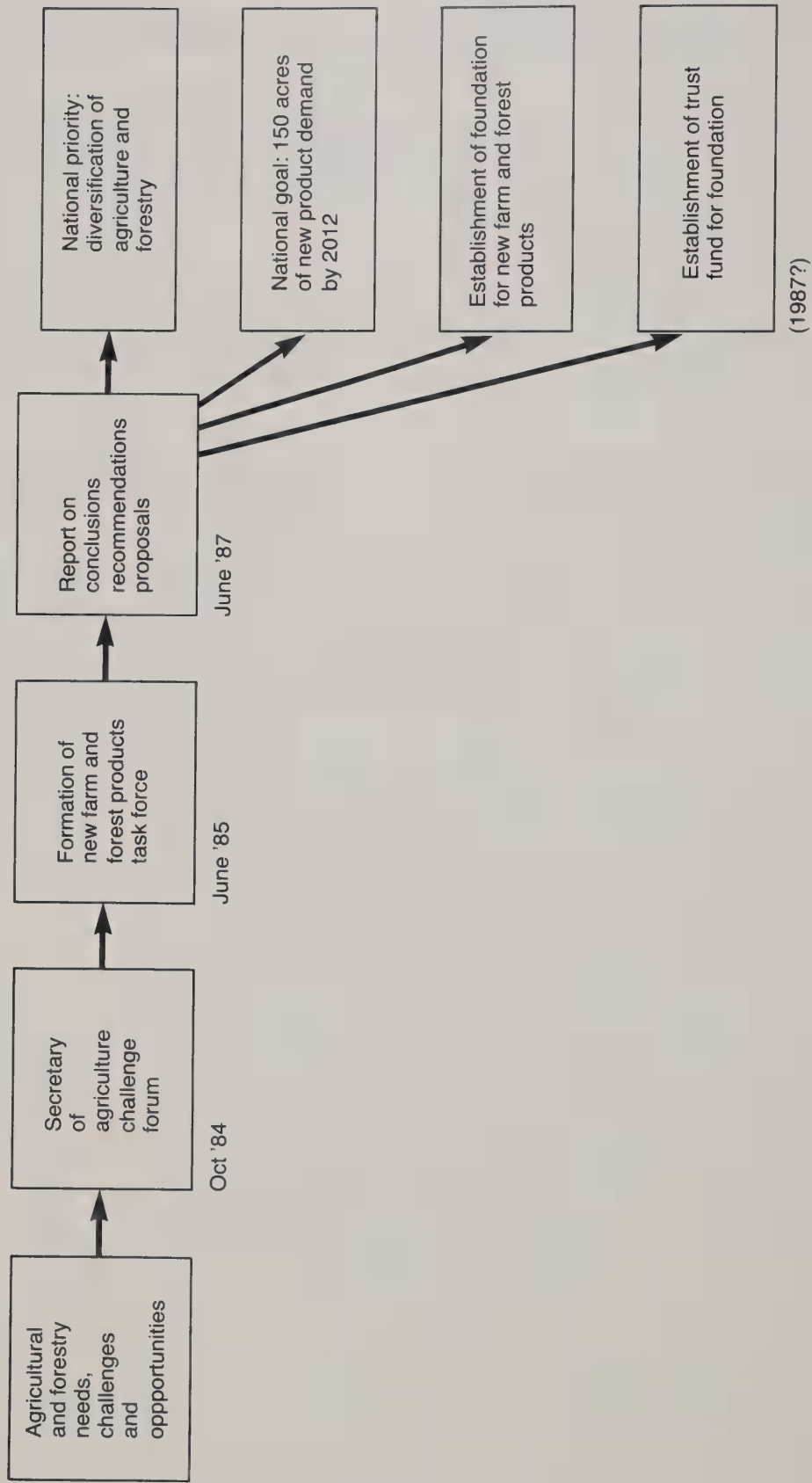
Consequently, a workshop group proposed that:

“...a mechanism be established under the direction of the Secretary of Agriculture to coordinate on a national scale objective-oriented research tasks and responsibilities for a few major identifiable projects in a specific time frame.”

An example offered for such a task force objective was the establishment of an objective to increase the export of U.S. beef by one million tons per year within ten years.

The New Farm and Forest Products Task Force agrees with this proposal. Indeed, the Foundation proposal in itself represents an analogous approach against a broad, long range goal. If the Foundation is established as proposed, it could serve as the vehicle to organize such task force efforts in areas within the scope of its mission. However, organization of such task forces in areas of current agricultural products should be undertaken by establishment of specific groups organized by producer associations, such as the national Corn Growers Association, with cooperation of relevant USDA agencies (i.e., in marketing and/or research areas).

Evolution of the New Farm and Forest Products Task Force





The New Farm and Forest Products Task Force recognizes that the recommendations and proposals presented above merely represent starting points for a needed and concerted national effort. The objective is to revitalize all sectors of U.S. agriculture through diversification, and thereby realize the full productive contribution that agriculture and forestry can make to the national economy.

There are, of course, no panaceas for the myriad of challenges facing agriculture and forestry, let alone the entire Nation. Nonetheless, the Task Force has a plausible vision of the agricultural and forestry industries of the future. The vision is one of dynamic, wholly revitalized industries - full of excitement, prosperity, and growth - and ones which are magnets for the country's best human resources.

The undertaking to move toward that vision through the diversification of agriculture is necessarily a long-term venture, and major results are not likely to be obtained before the end of the century. However, unless ideas, such as the ones suggested above, can somehow now be turned into action, the Nation is likely to be facing an agricultural and national crisis 30 years from now which is at least as grave as the one today.

As previously mentioned, exactly 30 years ago, the Task Group on New and Special Crops presented their findings and recommendations to the President's Appointed Bipartisan Commission on Increased Industrial Use of Agricultural Products. Their report makes very interesting reading, and much of what was said 30 years ago is essentially still true today. We members of today's Task Force sincerely hope that will not also be the case 30 years from now.

Relevant perspective comes from Mr. William G. Leshner, formerly an Assistant Secretary in the Department of Agriculture, who commented,

"In this day, when everyone seems to be looking for new growth industries that the U.S. can become competitive in, such as high technology, it is ironic that we could lose the most efficient industry we have, which is agriculture, through our own doing."

Additional perspective relevant to the proposals above comes from Professor James T. Bonnen of Michigan State University who wrote:

"Successful systems evolve in an iterative and interactive manner. They are not conceived or planned as a whole and then put into place. No one knows how to do that successfully. Scientific inquiry, policy, and institution building decisions are made under great uncertainty, with imperfect knowledge."

The New Farm and Forest Products Task Force believes that now is the time to begin the needed iterative and interactive process - if U.S. agriculture is to be fully revitalized to its maximum potential, and not lost as a cornerstone of American competitiveness and prosperity!



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**Acknowledgements from
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Similarly, although the findings of the Task Force do not necessarily reflect the views of any particular outside contributor to its work, the individuals listed below as Task Force Associates must be acknowledged. Although not a member of the Task Force, each Associate made substantive contributions to their work. The perspectives the Associates shared, and the time and effort they contributed, were much valued and appreciated.

Task Force Secretariat

(Note: The Secretariat was formed to provide liaison between the Task Force and the Department of Agriculture. With the exception of the Task Force Chairman, each member of the Secretariat was affiliated with the Department.)

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A Bill

To establish a Foundation for New Farm and Forest Products.

Draft Legislation

Be it enacted by the Senate and the House of Representatives of the United States of America in Congress assembled, that this Act may be cited as the "Foundation for New Farm and Forest Products Act of 1987".

Findings

SEC. 2. The Congress finds and declares that—

- (a) the agricultural products industry, the largest contributor to foreign export trade, is confronting strong competition in world markets;
- (b) emerging and developing nations are increasingly taking advantage of inexpensive labor and modern technology to produce crops far in excess of their needs, while other developed nations are increasing their agricultural productivity which in turn reduces their import requirement and/or increases their export surplus to compete with U.S. agricultural exports; and
- (c) as a result of the above, utilization of U.S. agricultural exports are shrinking, resulting in diminished demand, lower commodity prices, and lower profitability throughout agriculturally-related industries, causing significant losses to the United States economy.

Purpose

SEC. 3. It is the purpose of this Act through the Foundation established under section 5—

- (a) to mobilize private sector initiatives to capitalize on advanced technology unique to the United States and suitable for use by the agricultural and forestry industries.
- (b) to identify and develop through cooperative efforts between industry, universities and government laboratories industrial products needed to diversify markets for agricultural and forestry products; and
- (c) to promote shared risks, accelerated development time and pooling of skills which will be necessary to strengthen the agricultural and forestry industries.

Definitions

SEC. 4. As used in this Act—

- (a) the term "Foundation" means the Foundation for New Farm and Forest Products established by section 5;
- (b) the term "Secretary" means the Secretary of Agriculture;

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- (c) the term “Director” means the Director of the Foundation of New Farm and Forest Products, as provided for in section 5 (b) (2);
 - (d) The term “Board” means the New Farm and Forest Products Board as provided for in section 5 (b) (1); and
 - (e) the term “Fund” means the New Farm and Forest Products Fund, as provided for in section 11.

Establishment

SEC. 5. (a) There is hereby established in the executive branch of the Federal Government a Foundation for New Farm and Forest Products.

(b) There are hereby established in the Foundation—

- (1) a New Farm and Forest Products Board, to function in accordance with section 7; and
 - (2) an Office of the Director of the Foundation, to function in accordance with section 8.
- (c) The Foundation shall be located at a site within the United States to be determined by the Secretary, and shall be administered in accordance with existing Federal laws.
- (d) In addition to the Director, the Foundation shall have such other officers and employees as the Board may determine to be necessary or appropriate.

Functions of the Foundation

SEC. 6. The Foundation is authorized and directed—

- (a) to search out potential agriculture-based industrial products and processes;
- (b) to quantify the economic and technical parameters that must be met for commercial viability for any products or processes so identified by the Foundation;
- (c) to encourage and participate in cooperative programs; to facilitate the transfer of market relevant technologies from government laboratories to industry; to seek to capitalize on advanced technology; to develop proprietary agriculture-based industrial products and processes that will both expand and diversify agriculture in the United States; and
- (d) to further assist the formation of cooperative programs by entering into grants and cooperative agreements with other interested parties.

New Farm and Forest Products Board

SEC. 7. (a) The Foundation shall be operated under the general supervision and policy control of a New Farm and Forest Products Board, which shall consist of nine members, eight appointed by the Secretary, plus the Director.

(b) of the persons appointed by the Secretary to the Board—

- (1) one shall be from the Department of Agriculture;
- (2) one shall be from the Department of Commerce;
- (3) one shall be from the National Academy of Sciences;
- (4) one shall be from the membership of the Agricultural Research Institute;
- (5) one shall be from the membership of the Industrial Research Institute;
- (6) one shall be from farm/producer associations, beginning with the National Corn Growers Association; and
- (7) two shall be from private sector companies representative of industrial materials industries in the United States.

(c) The Secretary shall designate one member of the Board as chairperson and one member as vice-chairperson for a term of office not to exceed three years. The vice-chairperson shall perform the duties of the chairperson in the latter's absence. In case a vacancy occurs in the chairpersonship or vice-chairpersonship, the Board shall elect a member to fill such a vacancy.

(d) The term of office of each member of the Board shall be three years, except that (1) any member appointed to fill a vacancy occurring prior to the expiration of the term for which his predecessor was appointed shall be appointed for the remainder of such a term; and (2) the terms of office of the three members first taking office under subsection (b)(2) shall expire, as designated at the time of their appointment, one at the end of one year, one at the end of two years, and one at the end of three years. No member shall be eligible to serve in excess of two consecutive terms.

(e) The Board shall meet at least once every three months at the call of the chairperson, or upon the written request of two of the members. A majority of the voting members of the Board shall constitute a quorum.

(f) Members of the Board appointed from the private sector under subsection (b)(2) may receive compensation when engaged in the business of the Foundation at a rate fixed by the chairperson but not exceeding the daily equivalent of the rate provided for level GS-18 of the General Schedule under section 5332 of title 5, United States Code, and shall be allowed travel expenses as authorized by section 5703 of title 5, United States Code. Members who receive such payment shall not be considered employees of the United States.

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- (g) The Board shall, in addition to any powers and functions otherwise granted to it by this Act—
- (1) establish the policies of the Foundation, in accordance with applicable policies established by the President and the Congress;
 - (2) review the budget of the Foundation;
 - (3) review the programs of the Foundation;
 - (4) establish committees and procedures to approve or disapprove every grant, contract, or other funding arrangement the Foundation proposes to make, except that a grant, contract, or other funding arrangement involving a commitment of less than \$200,000 may be made by the Director without specific Board action, if the Board has previously reviewed and approved the program of which that commitment is a part.
- (h) The Board is authorized to appoint a staff consisting of professional staff members and such clerical staff members as may be necessary. The professional staff members may be appointed without regard to the provisions of title 5, United States Code, governing appointments in the competitive service and the provisions of chapter 51 of such title relating to classification, and may be compensated at a rate not to exceed the rate provided for level GS-18 of the General Schedule under section 5332 of such title.
- (i) The Board is authorized to establish such special commissions and contributing memberships as it may from time to time deem necessary for the purposes of this Act.
- (j) Board members shall be appointed not later than ninety days after the date of the enactment of this Act.

Director of the Foundation

- SEC. 8. (a) The Director of the Foundation shall be appointed by the Board, and approved by the Secretary. The Director shall receive basic pay at the rate provided for level II of the Executive Schedule under section 5313 of title 5, United States Code, and shall serve for a term of five years unless removed by the Board.
- (b) Except as otherwise specifically provided in this Act the Director shall exercise all of the authority granted to the Foundation by this Act.
 - (c) The Director may make such provisions as he deems appropriate authorizing the performance of any other office, agency, or employee of the Foundation of any of his functions under this Act.
 - (d) The Director shall formulate the programs and budgets of the Foundation, in consultation with the Board. As a basis for the selection and conduct of the Foundation's programs, the Director shall prepare, for the approval of the

Board, a short-range plan of activities and a long-range plan of activities. Each plan shall as fully as possible prioritize the full range of research activities appropriate to the Foundation. Such plans shall be prepared within one year after the initial selection of the Director, and each such plan shall be updated annually.

General Authority of the Foundation

SEC. 9. (a) The Foundation shall have the authority, within the limits of available appropriations, to do all things necessary to carry out the provisions of this Act, including but not limited to the authority—

- (1) to establish additional offices and other organizational structures within the Foundation;
- (2) to prescribe such rules and regulations as it deems necessary governing the manner of its operations and its organization and personnel;
- (3) to make such expeditions as may be necessary for administering the provisions of this Act;
- (4) to enter into grants, contracts, cooperative agreements, or other arrangements with whatever persons, organizations, countries, or other entities are deemed most useful by the Foundation to accomplish the purpose of this Act. Preference in such grants shall be given to proposals which are cooperatively funded by industry. Information received by the Foundation incident to this subsection shall be exempt from disclosure under section 552 of title 5, United States Code, and shall not be made publically available except in a judicial or administrative proceeding in which such information and material is subject to any protective order;
- (5) to require as a condition of any grant or cooperative agreement to which the Foundation is a party that any projects funded in whole or part by the Foundation shall pay an agreed upon royalty on sales to the Foundation;
- (6) to acquire, hold, or sell real and personal property of all kinds necessary to carry out the purpose of this Act;
- (7) to receive and use funds and property donated by others, if such funds and property may be used in furtherance of the purpose of this Act. For the purpose of Federal income, estate and gift taxes, such donations shall be considered as a gift or bequest for the use of the United States;
- (8) to accept and utilize the services of voluntary and uncompensated personnel, and provide transportation and subsistence as authorized by section 5703 of title 5, United States Code, for persons serving without compensation;
- (9) to arrange with and reimburse other Federal agencies for any activity which the Foundation is authorized to conduct;

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- (10) to receive funds from other Federal agencies for any activity which the Foundation or any such other agency is authorized to conduct; and
 - (11) to appoint and fix the compensation of personnel necessary to carry out the provisions of this Act.
- (b) Except as provided otherwise in this Act, appointments under subsection (a)(11) shall be made in accordance with the provisions of chapter 51 and subchapter III of chapter 53 of title 5, United States Code; but the Director may, in accordance with such policies as the Board shall prescribe, employ technical and professional personnel and fix their compensation, without regard to such provisions, as he deems necessary to carry out the purpose of this Act.

Annual Reporting

SEC. 10. The Director of the Foundation shall issue an annual report to the Secretary, detailing activities of the Foundation, including staff changes, status, and operational costs, together with an accounting of program allocations and project activity including the current status of each project.

New Farm and Forest Products Fund

SEC. 11. (a)(1) There is established in the Treasury of the United States the New Farm and Forest Products Fund. The fund shall be available to the Director, without fiscal year limitation, for use as a revolving fund to carry out activities of the Foundation.

- (b) There shall be deposited in the fund—
- (1) Interest earned by money invested by the Secretary in long-term securities;
 - (2) Payments received from any source for products, services or property furnished in connection with Foundation activities.
 - (3) Royalties earned by the Foundation from successfully commercialized products funded in whole or part by grants or cooperative agreements executed by the Foundation.
 - (4) Donations accepted by the Director on behalf of the Foundation, as provided for in section 9(a)(7).

Authorization of Appropriations; Related Matters

SEC. 12. (a) **Authorization of Appropriations.**—To carry out this act, there is authorized to be appropriated to the Secretary \$200,000,000 in fiscal year 1988, and each of the four fiscal years thereafter. The appropriations are to be obtained from the proceeds of the sale of various commodities held by the Commodity Credit Corporation each year during the five year period, and to be invested in long-term securities of the United States Government. Interest earned from these investments shall be paid into the fund.

Availability of Appropriated Funds.—After twenty years the money authorized under subsection (a) shall revert to the Treasury of the United States unless extended by the Congress.

Limitations on Expenditure.—Not more than 5 percent of the interest income paid into the fund in a fiscal year may be expended for administrative expenses incurred to carry out this Act.

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